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ABSTRACT

Prepared as a part of UNESCO's program in the teaching of science and technology, this pilot project was specifically designed to test interdisciplinary approaches in several countries and to disseminate the results to other interested countries. This guide reviews two approaches developed from the Scottish Primary Science Development Project and explains how science and technology concepts, processes, and skills can be developed within a multidisciplinary theme and be implemented by primary level teachers. Approach one includes two examples of integrated topic areas which focus on activities for the themes of "Time" and "Materials." The second approach consists of two units which highlight role playing in a developing storyline. These units are entitled "Journey to an Unknown Planet" and "Transport." Background information, instructional procedures, and illustrations are provided for all reviewed activities. (ML)

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The Teaching of Science and Technology in an Interdisciplinary Context

Approaches for the Primary School

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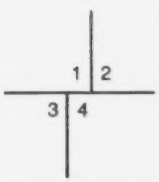

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Science and Technology Education
Document Series No.19

The Teaching of Science and Technology in an Interdisciplinary Context

Approaches for the Primary School

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Division of Science
Technical and Environmental
Education

UNESCO

ED-86/WS/38

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PREFACE

This document has been prepared within the framework of Unesco's programme in the teaching of science and technology. In particular it forms part of a pilot project on the teaching of science and technology in an interdisciplinary context. Experience in many countries suggests that the teaching of the concepts, processes and skills of science to children, may be more effective if it is linked with other subject areas than if it is presented as a separate subject. In particular, the links of science and technology in everyday life may become more 'real' to pupils if presented through interdisciplinary teaching. The purpose of this project was to test interdisciplinary approaches in several countries and to disseminate the results of this testing to other interested Member States.

There are many possible interdisciplinary approaches to science teaching. Two of these, based on experience gained in the Primary Science Development Project in Scotland, are described and exemplified in this document. The main aim in presenting these approaches is to show how specific aspects of science and technology can be developed within a study which involves a variety of curricular areas such as art, music, mathematics and language.

The selection of material and the opinions expressed are those of the authors; they are not necessarily those of Unesco.

INTRODUCTION

An interdisciplinary approach involving science and technology is frequently used in Scottish primary schools as a means of developing important concepts and process skills.

Only by examining in detail a selection of the key strategies used for a specifically selected topic or theme will it be possible to gauge the success of the method in terms of its set aims and objectives.

This report study, however, does not attempt to assess the interdisciplinary approach method against the cumulative effects of the differentiated curricular study approaches. Rather, the submission attempts to explain in detail TWO APPROACHES by which scientific and technological concepts, processes and skills can be developed within a multidisciplinary theme or topic study to be undertaken by primary pupils under the direction of their class teacher.

As in all teaching situations the role of the teacher is vital. Another important factor is the need for every school to have a policy for science teaching. In 1981 the Scottish Education Department set up the Primary Science Development Project (PSDP) to examine this feature in Scottish Primary schools (pupils aged 5 to 12 years). Their conclusion was that in order to develop in children a progression of skills schools needed to have a policy for science linked to a planned programme of study.

A series of eight booklets with associated case histories as appendices were produced to assist schools in formulating a policy and to help teachers implement this policy in the classroom.

Booklet 1 - Science in the Primary School - An Introduction
Booklet 2 - A School Policy for Science - A Rationale
Booklet 3 - Formulating a School Policy - A Strategy
Booklet 4 - Science in the Primary School - Activities in the Early Years
Booklet 5 - Links with other Areas of the Curriculum
Booklet 6 - Class Organisation
Booklet 7 - Assessment, Evaluation and Record Keeping
Booklet 8 - Resources

References will be made to these Booklets throughout this submission.

3. A SCHOOL POLICY FOR SCIENCE SHOULD -

3.1 define the place of science within the curriculum and its relationship with other subject areas.

3.2 indicate that the predominate teaching/learning style should be one that involves children in first-hand experiences which will develop scientific thinking.

3.3 set out a skeleton programme indicating those elements to be studied in depth, taking into account the ages and levels of achievement of the pupils, the strengths of the staff of the school and the school's location.

3.4 have a built-in order, sequence and structure.

3.5 outline the main aims towards which the teachers of each stage in the school will be working and how these relate to the overall school science programme.

3.6 ensure that all staff know the resources available and the system for borrowing and returning.

3.7 give an indication of the amount of time to be spent on science practical activities in each of the school years.

3.8 have a recognised plan for the organisation of outdoor activities and visits.

3.9 highlight features of the local environment (useful for fieldwork and as a resource) and any local supportive facilities (parents, experts, advisers, field centres, trails, ranger services etc.)

3.10 have a simple method a) of recording i) work covered
ii) assessment of pupil progress
iii) evaluation of the success/ failure of a study.
and b) for passing on these records to the next teacher.

N.B. Some of the above points on policy making apply to other areas of the curriculum. Many should have already been covered in the school's policy for Environmental Studies.

The detailed interdisciplinary approaches which follow must be seen in this light and not in isolation.

The Primary Science Development Project identified in Booklet 3 page 5 two main strategies used by schools to produce a policy for science education. These were called the "THEMATIC APPROACH" and the "CORE APPROACH".

4. DECIDING ON AN APPROACH

4.1 Effective science at the primary level should ensure that children by Primary 7 have had a planned programme of scientific experiences and have performed a variety of graded tasks which develop science process skills leading to an increase in their knowledge and understanding of key scientific ideas.

4.2 When considering how the science programme for the school is to be planned the headteacher must recognise that science will at different times be :

a) the central focus of an environmental studies theme

b) a peripheral study in a theme which is mainly based on some other area of the curriculum.

} This is the multidisciplinary/ cross curricular approach with science being planned through themes/ topics/projects/centres of interest. For simplicity this will be called the THEMATIC APPROACH.

c) a scientific study in its own right, which may or may not have a relationship to concurrent work in environmental studies or other curricular areas.

} Here either specific science based studies are selected from the four areas of study, detailed in an ordered, sequenced and structured way, and built in to a science programme for P1 to P7 or the need for a specific science based study is generated by thematic work. For simplicity this will be called the CORE APPROACH.

A school's programme should reflect both approaches.

In drawing up a programme, headteachers must take into account such factors as education authority recommendations and the stage their teachers have reached in science. If teachers feel insecure where science is concerned headteachers may find that, initially, science is better tackled in a structured way as in the Core Approach.

Each of the four exemplars of interdisciplinary methods which follow are planned to fit either of the above approaches and thereby strengthen the school policy. To simply plan to incorporate some science in isolation into a general class theme to which science has come previously or is planned subsequently negates the need for a planned policy and is unacceptable.

INTERDISCIPLINARY APPROACHES

Two different approaches are described with the main aim to show clearly how specific aspects of science and technology can be developed within a study which involves a variety of curricular areas such as art, music, mathematics, language etc.

Specific details are given of the science and technology activities to be undertaken and their relevance to the real world is stressed whenever possible.

The role and place of the educational inputs from the other curricular areas is of vital importance since the theme must develop naturally and be a coherent study with science playing, perhaps, only a minor role on occasion. Brief comments are made when and where appropriate of the other inputs. It is envisaged that other countries will use their own music, poetry and environmental links in place of those suggested.

Each approach will also describe in detail the teaching methodology behind the sequence of work to be undertaken.

A summary of these approaches is as follows :

Approach .	Interdisciplinary Theme/Topic
1. An Integrated Topic	'Time'
2. Role Playing in a Developing Storyline	'Journey to an Unknown Planet'

Two further exemplars (one for each approach) are included in summary form.

In the first instance it is hoped that teachers will attempt one of the themes suggested using the approach strategy described. Ultimately, however, the aim must be to use the approach with a NEW theme or topic and to move to an evaluation of pupil achievement using this approach compared to previous approaches. Aspects such as pupil motivation, enjoyment, social intraction as well as performance can be brought into the evaluation.

ORGANISATIONAL CONSTRAINTS : RESOURCES AND CLASS

No matter how full the descriptive methodology of approach or detailed the teacher notes and guidelines, other major factors like the logistics of the actual classroom, the resources on hand, teacher expertise and the like are vital matters affecting the translation of the approach description to classroom performance. Rather than comment in length within each of the approaches how some of these factors should be handled, the following general remarks are made.

(i) RESOURCES

Every effort has been made in the trials to minimise the resource needs. In the case of physical items only the simplest of equipment is required from the home (bottles, tins, shoe boxes ...) the hardware shop (nails, wire, batteries ...) and the general store (toys, elastic, pins, fabric, gum; ..).

While it would be an advantage to have modern childrens' books, charts, posters ... to enrich the theme or topic the exemplars described have been provided with specially designed pupil sheets and workcards. The stress has been placed on pupil activity using real objects. The technology sheets try to allow creative thinking and design activity with a variety of solutions possible.

It is hoped that teachers trying the material with their classes will improve on the design and graphics and go on to make up their own material on these and other topics.

(ii) RESOURCE ORGANISATION

This is a vital matter involving the school policy on resources as well as the classroom layout and provision.

The PSDP Booklet 8 'Resources' makes the following points :

1. ORGANISATION OF RESOURCES – AT SCHOOL LEVEL FOR TEACHERS

1.1 There is no single way of organising resources which will suit every school. However, sound organisation is essential if teachers are to be encouraged to undertake effective work in science. Materials and equipment need to be readily available, appropriate, useable and wide ranging.

1.2 The collection, organisation and maintenance of a good supply of resources can be undertaken by members of staff, pupils and parents. The co-ordination of their efforts is the responsibility of the headteacher or a teacher/group of teachers to whom this is delegated.

3. ORGANISATION OF RESOURCES – AT CLASS TEACHER LEVEL FOR PUPILS

3.1 Just as with centrally held resources the organisation of class held resources needs to be tight if it is to be workable.

3.2 Train pupils to use properly the central resources area and those held in the class area.

3.3 Well before starting a study, list all the materials pupils are going to need and arrange to have them readily available. Some materials can be collected when work is under way e.g. things to be borrowed, but note these and collect in good time. Sometimes the work will involve the pupils making their own collections of materials.

3.4 If larger pieces of equipment are shared and need to be returned to central resources area every day, train pupils to do this properly.

(iii) CLASS ORGANISATION

There are many ways in which a science lesson can be undertaken once the resource provisions and classroom layout have been decided on. To detail or prescribe a teaching style within the four approaches described is not considered sound. It is up to the class teacher to decide on an appropriate teaching style taking into account the many variables specific to her/his situation.

The following extracts from PSDP Booklet "Class Organisation" are helpful in coming to a decision on an aspect of science or technology work to be given to the class.

PSDP Booklet 6 Page 1

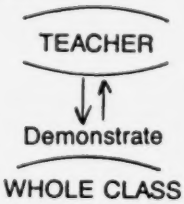
2. WAYS OF ORGANISING A CLASS

2.1 As in other curricular areas, there are many different ways in which a teacher can organise a class for science. There is little doubt, however, that the advantages of group teaching outweigh the extra effort involved in implementing this. There will, of course, be occasions when class and individual teaching/learning situations will be appropriate.

2.2 The composition of the groups will be dictated by the particular needs of the pupils involved and the learning experiences the teacher wishes them to have. This means that for some of the time the children might be grouped according to friendship/social groupings. One of the advantages of this is that it will allow pupils of lesser ability to work alongside more able pupils. This will have social benefits and very often children of lesser ability have more success when involved with practical activities. Care should be taken that where friendship groups are formed the less able child is seen to be contributing to and participating in group work. There may be occasions when, for specific purposes, the teacher wishes to group the children according to interest. This has the benefit of leading to high group interaction. On other occasions there may be a need to form ability groups. This will allow children to work at a pace suitable to them and may give opportunity for a more in depth approach for the more able pupil.

WHOLE CLASS/DEMONSTRATION LESSON

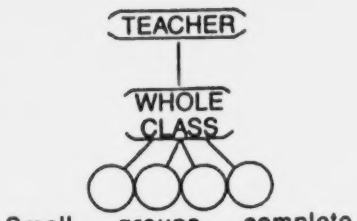
Whole class.
Teacher gives demonstration or calls upon individual children to demonstrate to the class. This method may be used to demonstrate a technique e.g. measurement, or to train children in a way of working.



Teacher interaction with whole class

SMALL GROUPS WITH SAME/SIMILAR ASSIGNMENTS

Children in small groups or individually completing similar or the same tasks at the same time after an initial introduction by the teacher.



Small groups complete **same/similar activity, at the same time.**

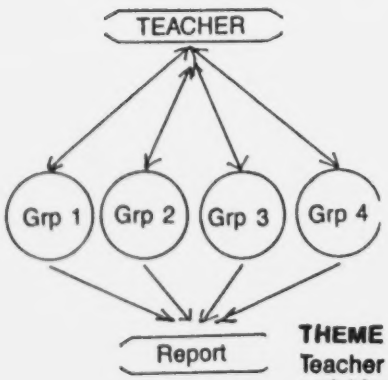
SCIENCE AREA/SINGLE GROUP ORGANISATION

Teacher introduces topic to class and divides class into groups who then complete the same given task at different times of day/week. Remainder of class not necessarily involved in science at this time. One area of the class may be set aside for this activity. Shared discussion after all groups complete assignment.

Individual groups complete **same assignments at different times.**

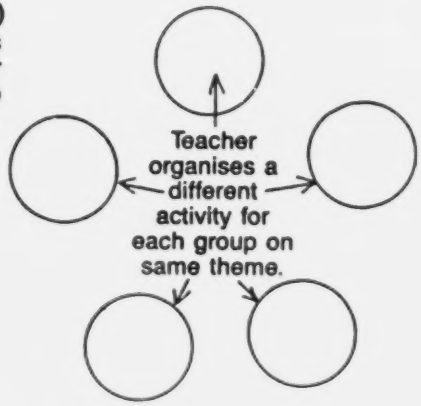
SMALL GROUPS — DAILY ASSIGNMENT METHOD

Each group given an assignment to complete in the day. Indication given where teacher assistance is necessary. Stock of extension activities available.



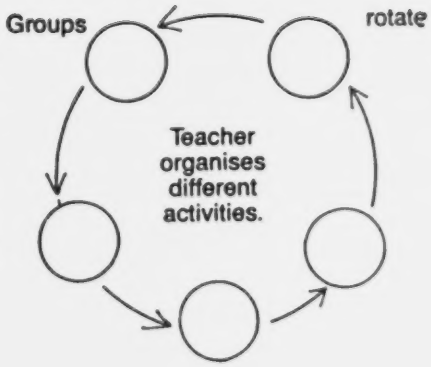
THEME APPROACH (1)

Teacher sets up various activities on a particular theme. Each group completes **one** activity.



THEME APPROACH (2)

Teacher sets up various activities. These might be independent or thematic relating to a topic (e.g. sound) or a skill (e.g. measurement). Groups rotate around activities. All children complete **all** activities.



APPROACH 1

EXEMPLAR 1

Rationale

Although often thought of as too abstract a topic for young children, time can be introduced at any stage of the primary school. Even very young children are able to investigate how long it takes sand to run out of a container compared with water from the same container. They can use simple instruments such as 'tocker' timers or egg timers long before they can use clocks or watches and so be introduced to the passage of short intervals of time.

The following example is aimed at children aged nine to eleven years, most of whom are able to 'tell the time'. The basis of the project was the Science 5/13 unit "Time" and reference was made to several work card publications which were modified to suit the classes involved.

The aims of the project were :-

(i) to enable the children to learn about the passage of time as a span of years, days, hours and minutes

(ii) to enable the children to experience the passage of short intervals of time and so help build up a concept of time

(iii) to have children investigate the different ways time can be measured and thus develop scientific skills such as observing, measuring, estimating, being aware of variables and throughout to develop mathematical skills as well as a variety of language skills.

When faced with the task of making their own timer, children will not only be involved in problem solving but also in designing, making and testing their own machine - technology.

The approach suggested is one where many curricular areas are based on the topic. A series of lessons is laid out in a suggested sequence, with the different subjects slotting naturally into the basic programme. Details are given of the science lessons but less for the other subject areas. Suggestions are made for language, mathematics and art work but teachers should adapt these or indeed add their own, to suit their own particular situations. This is even more true of the geographical and historical aspects. There is however much difficulty in separating subject areas in this kind of approach as Language occurs in every lesson and mathematics in most lessons while the other subjects impinge on a great many. The ideas given are meant only to be starters but there are many other avenues which teachers can follow.

A variety of ways of organising the class is used and the different methods, based on those of the Primary Science Development Project outlined on page 6/7, are noted at the start of each lesson. Again it is assumed that individual teachers will modify these according to their own experience and the experiences of their pupils.

EXEMPLAR : 'TIME AS AN INTEGRATED TOPIC

Summary of Suggested Sequence of Lessons

Order	Curricular Area	Lesson Title
Lesson 1	Starting Point	'Collection of old clocks'
Lesson 2	Language	'How quickly/slowly do we do things?'
Lesson 3	Mathematics	'The 24 hour clock'
Lesson 4	Art	'Designing own clock face'
Lesson 5	Mathematics	'Revision of 24 hour clock'
Lesson 6	Language	'A novel'
Lesson 7	Science & Technology	'The passage of time'
Lesson 8	Science & Mathematics	'Timing activities'
Lesson 9	Art	'Printing using cog wheels'
Lesson 10	Mathematics	'Block graphs and pie charts'
Lesson 11	Science & Technology	'Using the sun as a clock'
Lesson 12	Mathematics/Geography	'Time around the world'
Lesson 13	Geography	'Study of a country'
Lesson 14	Science & Technology	'Candle clocks'
Lesson 15	Language	'Creative/imaginative writing'
Lesson 16	Drama	'A real life auction'
Lesson 17	Mathematics	'Train or bus timetables'
Lesson 18	Science & Technology	'Sand and water clocks'
Lesson 19	History	'Ancient Egypt'
Lesson 20	Language	'Poetry'
Lesson 21	Science & Technology	'A dial water clock'
Lesson 22	Art	'A time ship
Lesson 23	Science & Mathematics	'The pendulum'
Lesson 24	History	'My family tree'
Lesson 25	Science & Technology	'Reaction time'
Lesson 26	Science & P.E.	'Body times'
Conclusion	All	'A Science & Technology fair'

Analysis of Topic - 'Time' - for Pupils aged 9 to 11 Years

Lesson 1 - Starting Point

Organisation - Class lesson centred around a collection of clocks, watches timers and bits and pieces of old clocks. Discuss with the children the various items and relate to their use. A 'Word Bank' should be constructed of words associated with 'time'. This should be added to throughout the project.

(There are many other starting points, some teachers started their project off by reading the children an extract from a story with a 'time' theme and followed this by having the children research a period in history; another posed the problem of how we could measure time if we had no clocks or watches).

Lesson 2 - LANGUAGE - 'How quickly / slowly do we do things'

Organisation - Class lesson with individuals given same task.

Tell the children to :-

(i) Make a list of things they do quickly (e.g. drink 'pop', run, eat sweets etc)

(ii) Make a list of things they do slowly (e.g. write, get dressed, etc)

Add new words to 'word bank'.

Introduce a 'Phrase and Sayings' bank, tell children to write in this sayings associated with time such as 'slow coach', 'quick as a flash' etc. Add to this as project develops with others such as 'more hurry less speed', 'a stitch in time saves nine' and so on.

Lesson 3 - MATHEMATICS - 'The 24 hour clock'

Organisation - Class lesson with individuals given same task.

Introduce 24 hour clock and use examples based, initially on school times and times children are familiar with e.g. breakfast, lunch and dinneretc.. Ask children to write down everything they did in the past 24 hours (i.e. from start of school yesterday to start of school today). Put these into lists and add times using 24 hour clock. This can be presented in the form of a table.

Example :-

My last 24 hours - Tuesday to Wednesday

Name - George MacIntyre

	Time		Activity
Tuesday	0900 hours	School -	Reading
	0930 hours		Maths
	1030 hours		Playtime
	1045 hours		English
	1245 hours		Lunchtime - left school for home
	1230 hours	Home -	Ate lunch
	1310 hours		Left home for school
	1330 hours	School -	Art
	1430 hours		Project
	1530 hours		Left school for home
	1600 hours	Home -	Changed, had glass of milk plus bread and jam. Played with friends
	1700 hours		Watched T.V.
	1800 hours		Tea
	1845 hours		Played football
	1930 hours		Watched T.V.
	2130 hours		Bed, read, slept
Wednesday	0745 hours		Got up, washed, had breakfast, brushed teeth, packed school bag
	0835 hours		Left for school
	0900 hours	School	

Have children repeat this for a Saturday or Sunday and compare tables.

Lesson 4 - ART - 'Design'

Organisation - Individuals given same task.

Ask children to design their own clock face.
Discuss the importance of relating design to function. As well as making the clock face attractive they must ensure that the time is easily read. Is the clock for a child, a teenager or an old person? How would these factors influence the design?

Once the children have completed their clock faces, display their completed works in the different categories.

Lesson 5 - MATHEMATICS - 'Revision of 24 hour clock'

Organisation - As for lesson 3.

Ask the children to use the information they produced for lesson 3 to work out the time spent in school compared with the time spent at home.

Example :-

Name - George MacIntyre

School - 0900 hours to 1215 hours = 3 hours 15 minutes
1330 hours to 1530 hours = 2 hours
Total time = 5 hours 15 minutes

Home - 1230 hours to 1310 hours = 40 minutes
1600 hours to 0835 hours = 16 hours 35 minutes
Total time = 17 hours 15 minutes

Walking to and from school - 1215 hours to 1230 hours = 15 minutes
1310 hours to 1330 hours = 20 minutes
1530 hours to 1600 hours = 30 minutes
0835 hours to 0900 hours = 25 minutes
Total time = 90 minutes
= 1 hour 30 minutes

Add times to check
School = 5 hours 15 minutes
Home = 17 hours 15 minutes
Walking = 1 hour 15 minutes
Total time = 24 hours

Ask the children to work out the times spent on the various activities during the 24 hour period.

Lesson 6 - LANGUAGE - 'A Novel'

There are many novels with a 'time' theme.

The teacher should select one that is most suited to her pupils and that fits the school's language policy.

The development of the work associated with the novel is again dependent on the individual teacher, her pupils and the school policy.

Some novels with a 'time' theme :-

Tom's Midnight Garden	- Philippa Pearce
The Guardians	- John Christopher
Charlotte Sometimes	- Penelope Farmer
A Wrinkle in Time	- Madeleine L'Engle
Stig of the Dump	- Clive King

INTRODUCTION TO GROUP WORK

SPECIAL NOTE -

A great many of the lessons that follow are best tackled by children working in groups. It is recommended that a teacher who is inexperienced in this way of working, approaches group activities as a phased operation. The initial organisation should be groups (of three or four children) working at the same activity, then similar activities before attempting different activities. This is not only economical with respect to different kinds of materials and resources, but it also allows the teacher to be concerned with only one activity at the start of group work. This 'shallow-ended' approach enables the teacher to build up her confidence.
See pages 6&7 which follow the pattern laid out in PSDP Booklet 4 (Organisation).

It is important that during group work, the teacher discusses the activities with the children and that she circulates round the groups, listening to their talk and feeding 'clues' where appropriate.

Lesson 7 - SCIENCE - ' The Passage of Time '

Organisation - Groups carrying out the same task.

Give each group a stop clock or other timing device (children could use their own watches if these display seconds).
One member of group acts as timekeeper.
She starts the clock and the others have to indicate when they think one minute has passed. Note the differences between correct time and their estimates.
Repeat with the children reading a book, counting up to sixty etc.
Compare the differences in times.
Give everyone in the group a chance to be timekeeper.

Lesson 8 - SCIENCE / MATHEMATICS - 'Timing Activities'

Organisation - Groups given similar tasks.

Discuss with the children the kind of activities that are suitable for timing (e.g. writing letters of alphabet, writing numbers 1 to 100, finding the total of 50 coins of various values etc.)
Give each group a stop clock or other timer (again children could use their own watches if suitable).
Tell children to choose two or three activities.
Tell them to draw up a table (see below) and to write down how long each member thinks the activity will take.
Have one person time the others at the activity, enter the actual time taken in table.
Repeat for the other activities, using a different timekeeper.
Compare the times.

Specimen Table :-

Activity	Name - _____		Name - _____		Name - _____	
	Estimate time	Actual time	Estimate time	Actual time	Estimate time	Actual time
Writing the letters of the alphabet						
Walking round the room						
Walking round the room balancing a a book on head						

Timing Activities

How long will it take Fiona to walk along the corridor balancing a book on her head?

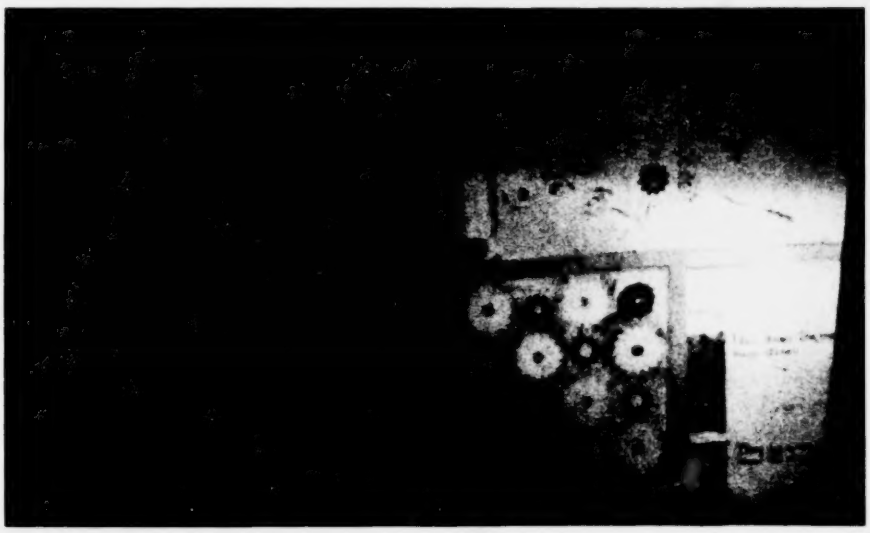
Lesson 9 - ART - 'Printing / Painting'

Organisation - Class with children working idividually at same task.

Children use cogs and other bits and pieces from old clocks from initial display to create different patterns.
Different media such as poster paint, crayon etc. can be used.

Various techniques can be introduced such as contact printing, spray printing rubbing etc.

Examples of children's work

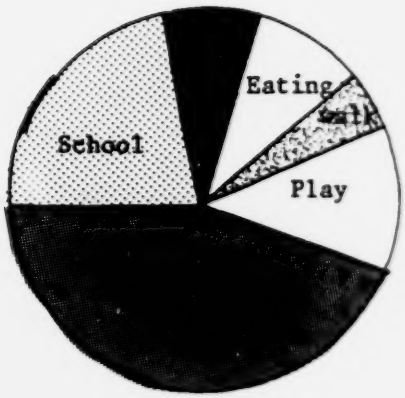


Lesson 10 - MATHEMATICS - 'Block Graphs and Pie Charts'

Organisation - As for lessons 3 and 4.

Children use the times from lessons 3 and 4 to draw block graphs and pie charts.
These will then show the proportions of the 24 hour period spent on their different activities.

Example :-



SCIENCE - 'Making Clocks and Timers'

This is the start of much practical work and the lessons listed are intended for a period of days or weeks. The actual placing and timing of the lessons will depend on the availability of materials; the interest of the children and other school activities.

It must be stressed that no matter what the activity is or how many are being attempted the teacher must have gathered together and made readily available adequate resources before each lesson.

The school should also have decided on a policy for record keeping (see PSDP Booklet 7) and a simple method is given below.

A sample completed record is given on page 40.

												START:							
												COMPLETE:							
Group	Group/pupil names	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete

Lesson 11 - SCIENCE - 'Using the Sun as a Clock'

Organisation - Groups carrying out same activity.

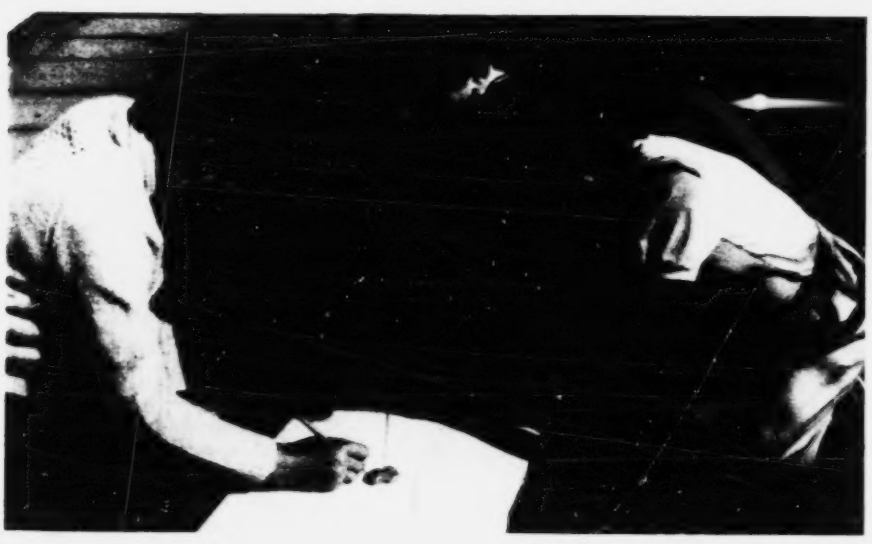
(N.B. Instruct children never to look directly into the sun)

A. Ask the children to keep a record of where the sun is in the sky at different times of the day e.g. when they get up in the morning, at start of school,at lunch time, tea time, bed time etc..

B. Shadow Clocks

Give each group a piece of wood or hardboard 15 cm square to use as a base, a lump of plasticine and a straw. Tell them to fix the straw in a vertical position in the centre of the base using the plasticine (how do we find the centre of a square?). Allocate a different part of the playground to each group. Tell them to place board on ground and mark its position. On the base draw the shadow cast by the straw and note the time. Repeat every hour. At the end of the day compare the positions and lengths fo the shadows. This activity can be repeated the next day and it can also be carried out at different times of the year and linked with work on the seasons.

Refer children to books with information on sundials.



Lesson 22 - Art - 'A timeship'

Organisation - Children working individually.

Ask the children to design their own timeship.

There is a great deal of scope in this lesson for imaginative planning as well as fun. The end product of this lesson could be used as a starter for a historical study as an alternative to lesson 18.

The children could imagine that they were in their timeship and travel back to the period in history to be studied. This can lead to imaginative writing.

Example -

"*My Spaceship*

In my spaceship there are lots of switches. Here is one that that says 'future' and the red one says 'past'. I'll press the future one to see what happens. Oh I am whirling through a long pipe and it is going so fast I wonder what it will be like. I am scared. Oh what a bump, I have landed. Should I open the door, I wonder what's outside.

I am opening the door. Look everyone is all around the space ship. A girl is coming towards me and she is taking me to house that is under the ground. It is big and has no windows. The girl is a nice girl she haslong golden hair and teeth like twinkling stars. She wears a long golden dress with silvery stars on it. She is offering me food and wine. I don't know what the food is called because I have never seen it before.

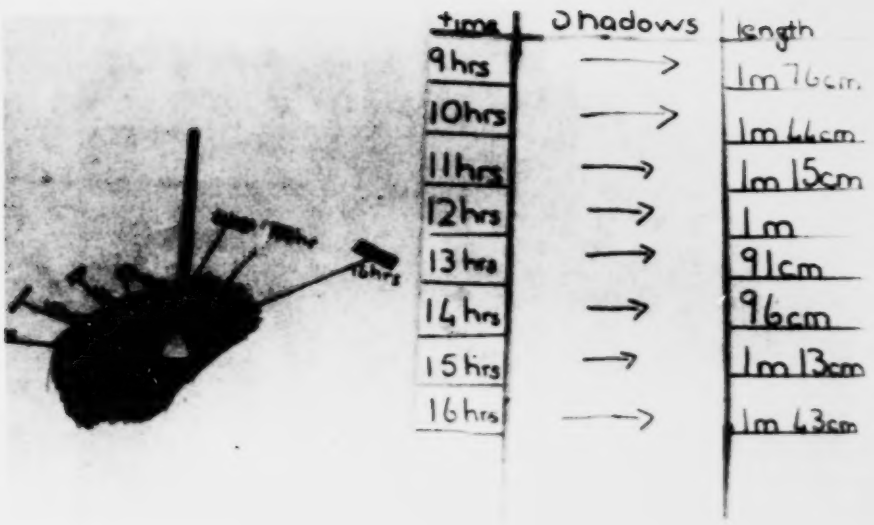
The people look friendly and happy and I dont want to go back to my own time. All the ladies and girls have long golden hair and the boys have frizzy hair which is black.

They have dug me an undreground house like their own and there is beautiful furnisher in it.

The girl's name is Rosey and she is the leader.

Rosey is asking me to stay and I have decided to stay.

I hope everybody in my own time does not miss me."

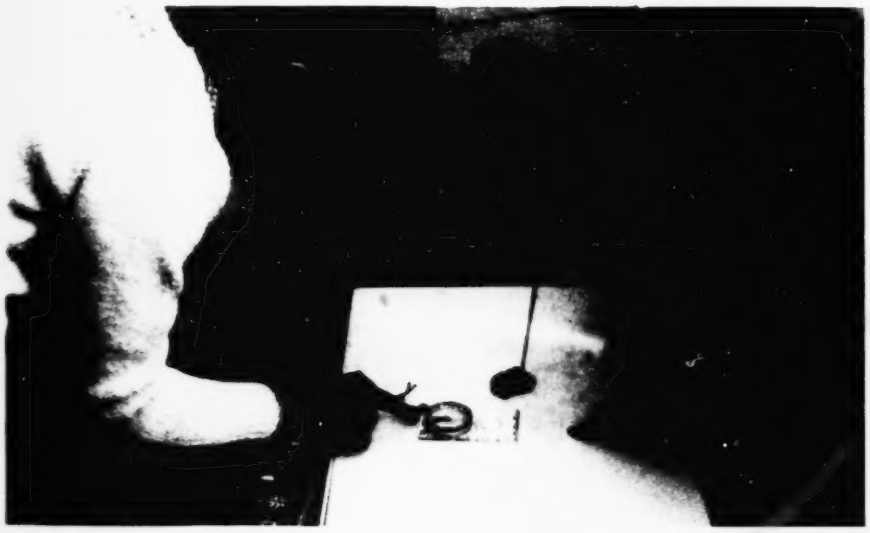


Example of children's work on shadow clock

Lesson 12 MATHEMATICS / GEOGRAPHY - 'Time around the world'

Organisation - Groups as for lesson 11.

Give groups a compass and tell them to take base used in lesson 11 and place it in its position on playground.
Tell them to mark the points of the compass on the base.
Use this as a starter to relating the rising and setting of the sun to the rotation of the Earth.
Develop lesson on time zones.



Lesson 13 - GEOGRAPHY

The work carried out in lesson 12 on time zones can be used as a base for integrated work in Geography.
Refering to school's policy for Geography, select the country to be studied and introduce study by using time zone work.

Lesson 14 - SCIENCE - 'Candle Clocks'

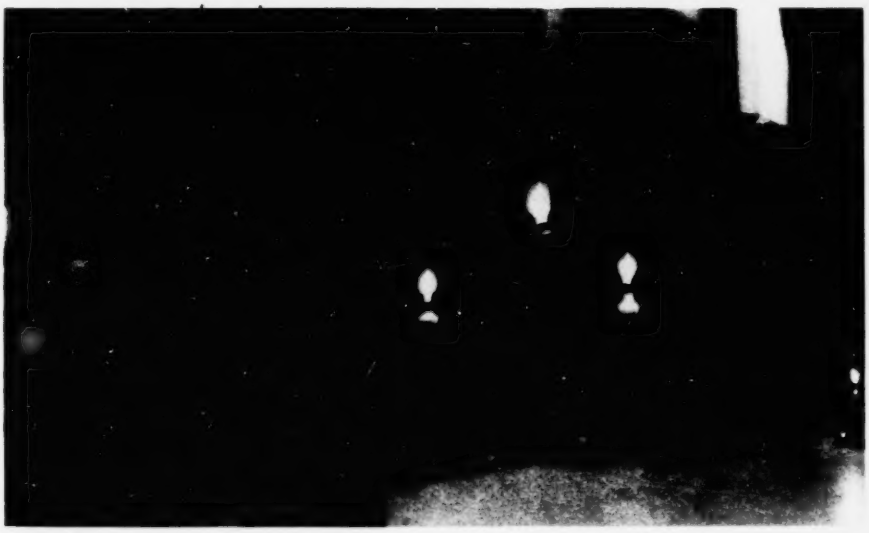
Organisation - Groups carrying out same / similar activities.

A. Give each group two identical candles and a stop clock or other timing device. Tell children to fix candles to upturned metal lids and place side by side. Light one of the candles. When it has burned for 5 minutes mark its height on the other candle. Repeat every 5 minutes.
N.B. The time interval may have to be adjusted depending on the type of candle being used.
After the candle has finished burning the remaining one will have a series of marks on it. Tell the children to copy the marks on to a similar candle.
Tell the children to use these 'new' clocks to measure different time intervals during the day (e.g. lunch interval, afternoon session, length of a lesson etc.).

B. Give each group several different candles. Ask the children to examine each and say whether they think these candles will burn more slowly or quickly than their original one. Tell them to measure the heights and diameters of the candles before lighting them to compare their rates of burning.

Can the groups work out how many birthday candles 'are the same as' an ordinary candle?
Can they make up their own table of time based on their candles?

N.B. SINCE A NAKED FLAME IS INVOLVED THE CHILDREN MUST BE WARNED OF THE DANGERS INVOLVED AND THE TEACHER MUST BE EXTREMELY VIGILANT.



SPECIAL NOTE -

This group lesson and many of the others that follow lend themselves to a reporting session at the end where the different groups tell the rest of the class what they did and what their findings are. This is an important activity as it not only gives the children experience in public speaking but entails them in keeping clear, concise and accurate notes. Initially the report could be quite short so that the children can gradually build up their confidence. Eventually the 'audience'could be allowed to ask questions and the reporters would then have to develop higher order skills.
The children might even demonstrate their activity as part of their report.

This shows one group explaining their investigation to the rest of the class.

Lesson 15 - LANGUAGE - 'Creative / Imaginative Writing'

Organisation - Children working individually within a class lesson.

A great variety of imaginative situations can be constructed around work with candles.

Suggestions :-

' Stare into the candle flame, let your mind wander, write down your thoughts.'

'Imagine you are living in the past. Your house is big, dark and draughty, the only light is coming from a flickering candle flame. The wind is whistling through the ill-fitting doors and windows. Look at the dancing shadows caused by the candle flame. Write down what happens next.'

Lesson 16 DRAMA - "A real life auction"

Organisation - class or groups as before.

Select an auctioneer, teller, seller etc.

Rest of class act as buyers.

Give buyers tokens to represent money.

Choose an article - could be a stopclock or the like to be auctioned.

Take a small candle, stick a pin in it about half way down.

Rules bidding starts when candle is lit and highest bid given when the pin falls wins the article.

Lesson 17 - MATHEMATICS - 'Train or Bus Timetables'

Organisation - Groups or individuals.

Various exercises in mathematics can be developed from timetables which are now based on the 24 hour clock.

The teacher should select examples of varying degrees of difficulty to suit groups or individuals.

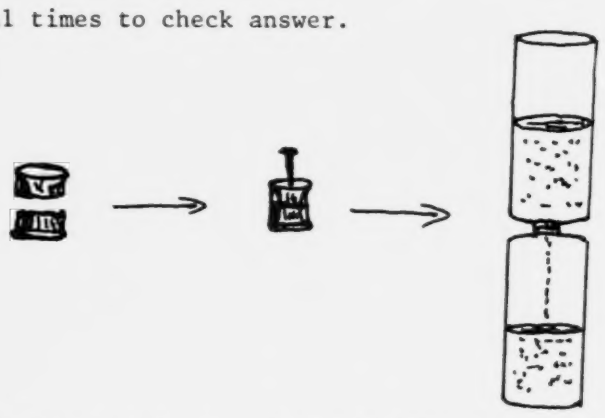
Obviously the lesson is made much more interesting if the children are placed in a situation where they have to solve a problem which is directly related to themselves.

Lesson 18 - SCIENCE - 'Sand Clocks and Water Clocks'

Organisation - Divide class into two sections. The groups from one section will investigate sand clocks and the groups from the other section will investigate water clocks.

A. Sand Clocks

(i) Give the group two clear plastic bottles with metal lids, a hammer, a nail, some fine dry sand and a stop clock (Children's own watches will do).
Tell the children to stick the metal lids together and punch a hole through the middle. Fill one bottle with sand and fit lids. Place the second bottle on top, turn them upside down and time how long it takes the sand to run out of the bottle.
Repeat several times to check answer.



What happens if the bottle is only half full of sand?
Use the timer to time various classroom activities.

(ii) Give the group a plastic washing up liquid bottle with the bottom cut off, a clear plastic jar, a timing device and some dry sand.
Tell the children to clean and dry the bottle (why?), place it on top of the jar, fill the bottle with sand and time how long it takes to fill the jar.
Repeat but this time mark the level of the sand in the jar every minute (time interval may have to be adjusted depending on the diameter of the jar).

Another variation is to mark the jar at cm intervals and note the time it takes the sand to reach each mark.

Children could give a name to this 'new' unit of time and construct their own table of time based on it.

(iii) Tell the children to try (i) and (ii) using other substances such as salt and sugar. Which one makes the best timer?

Children investigating reaction time.

A group of children calibrating their sand clock.

B. Water Clocks

(i) Dripping Water Clock

Give the group a clear plastic bottle, a nail and a can or plastic jar. Tell the children to make a hole in the bottom of the bottle and place it on top of the can. Fill the bottle with water and using a stop clock or other timing device, time how long it takes the bottle to empty. Repeat several times to check result.

Repeat but this time mark the level of the water in the bottle every minute (if marks are too close together or far apart, alter the time intervals). When the bottle is empty examine the marks.
Refill the bottle and repeat.
Are the marks consistent?
Can this be used as a timer?
Try it out by timing several classroom activities.

A group of children checking to see if the marks on their dripping water clock are consistent.

B. Water Clocks

(ii) Sinking Water Clock

Give the group a small flat tin, a hammer, a nail, a basin of water and a timing device.

Tell the children to make a hole in the bottom of the tin and place it on top of the water. Time how long it takes to sink.

The children may be faced with the problem that the tin will not sink but they should easily solve this.

Tell them to make two holes and compare the times of sinking.

Repeat with three or four holes.

Tell the children to draw a graph of the times taken for the tins to sink against the number of holes in the tins. Ask them to look for a pattern.

Can they use their graph to predict the time it will take if the tin has five or six holes?

Tell them to try these out to check their predictions.

How long will it take the tin to sink when it has five holes?

(iii) Tell the children to try (i) and (ii) using hot water or water to which detergent has been added. Ask them if they think this will have any effect. The children could try other liquids and compare results.

If the children's interests are sustained, the groups could change over and those who investigated sand clocks could work on water clocks and vice versa.

Lesson 19 - HISTORY - 'Ancient Egypt'

Organisation - Groups as for lesson 17.

Children could research the ways the ancient Egyptians measured time . Egyptian water clocks could be made as a starter to an historical study of life in those times.

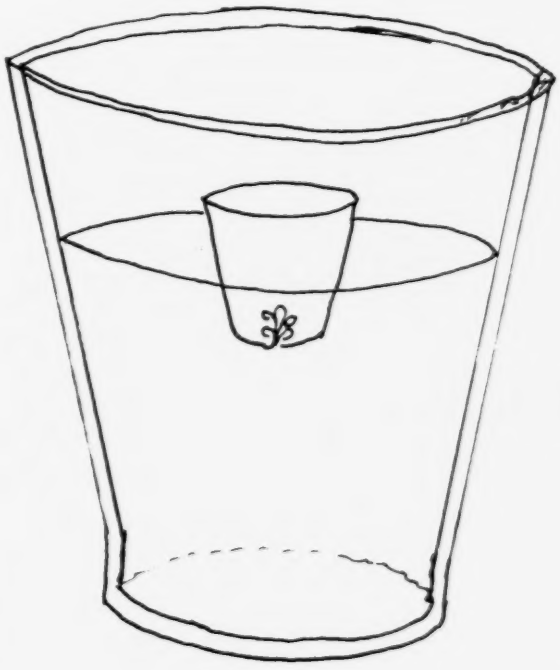
This work would be on-going throughout the project similar to the work in Geography of lesson 13.

Where possible this study could be linked to a visit to a local museum.

Background note

The first mechanical device for measuring time was the water clock or clepsydra, which depended for its operation on water flowing out of or into a vessel. A simple Roman version consisted of a metal cup with a small hole in it. This was placed in a bucket of water and would sink after a fixed period. The Egyptians favoured water flowing out of a graduated vessel, but this presents problems (see lesson 18 B (i)) since the rate of flow depends on the water pressure, which decreases as the water flows out. This is why the pupils' scale from that lesson is not linear.

Roman Water Clock



Lesson 20 - LANGUAGE - 'Poetry'

As was the case for novels, there are a great many poems with time as a theme. The teacher should again choose poems that are suitable for her children and that fit the school's language policy.
Again this work should be on-going throughout the project.

Some poems with a 'time' theme :-

The Grandfather Clock	by H. Chesterman
Leisure	by W.H. Davies
A Time to Every Purpose	Ecclesiastes 3, 1 - 8
Lost Time	by Ffrida Wolfe

A school's Poetry Corner

Lesson 21 - SCIENCE - ' A Dial Water Clock'

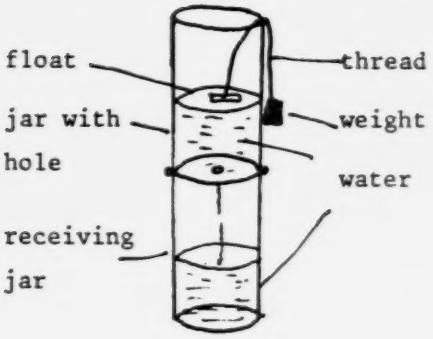
Organisation - Groups as in lesson 17.

Children are used to seeing clocks with a dial and hands that move round.

Present the groups with the problem of designing and making their own, based on their water clocks.

Obviously some clues may have to be given. (e.g. the idea of a float being used could be introduced first - see diagram 1)

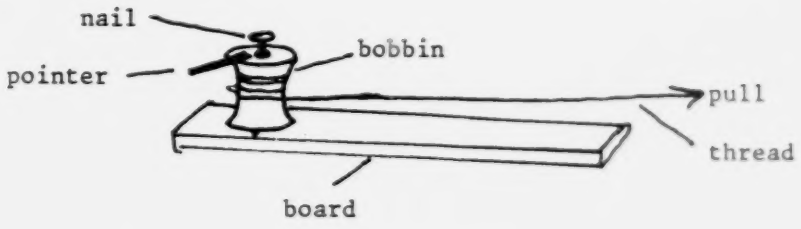
Diagram 1



As water moves down the float sinks and the weight rises.

The problem of transfering this vertical motion to circular motion can be introduced by refering the children to work on wheels.

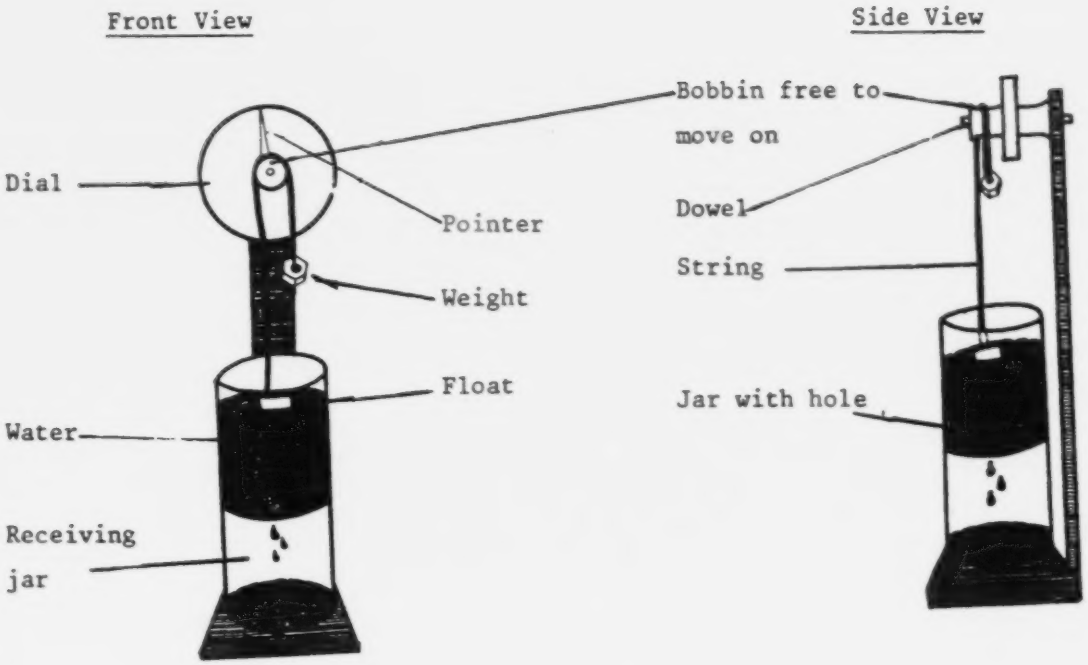
Diagram 2



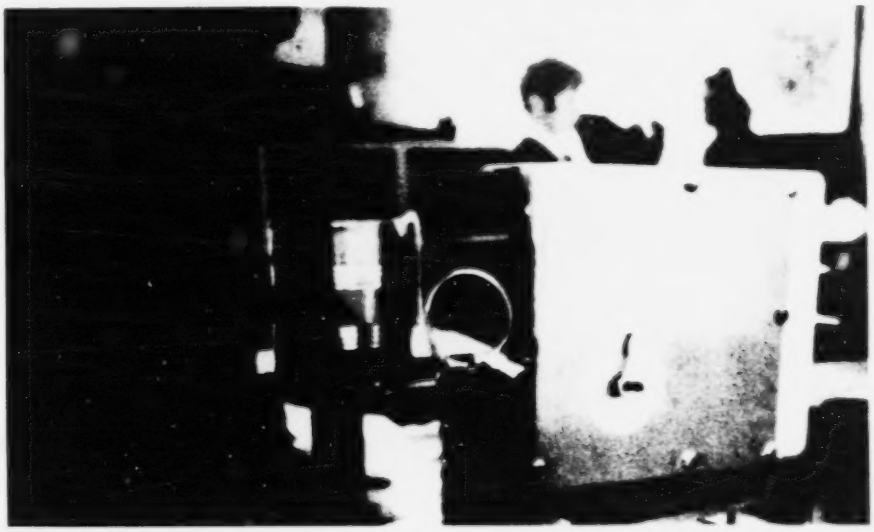
What happens to pointer when thread is pulled?

Allow pupils to 'play' (experiment) with several bobbins linked together with elastic and fixed to the board. This will give them much experience on 'belt drive', 'wheels' etc.

Possible solution



As water drops out of top jar the float drops and pulls the string which turns the bobbin and the pointer moves round the dial. The instrument can be calibrated using a timer or arbitrary units again introduced.



A boy's dial water clock

Lesson 23 - Science / Mathematics - 'The pendulum'

Organisation - Groups working at different aspects of same topic.

Give each group string, a weight (plasticine will do), and a timing device (give each group a different device). Ask the groups to tie the weight to the end of the string fix the other end and find the time for one swing. This is a good introduction as it provides a great opportunity, not only to discuss variables (such as length of string, size of weight and also size of swing), but also opens the way for work on experimental error (such as timing one swing as opposed to timing ten swings, use of 'correct' instrument, repeating the measurements etc.

Divide the class into three sections. The groups from one section will investigate the effect of altering the length of the string, those from the second section will investigate the effect of altering the weight and the third the effect of altering the size of the swing.

(i) Length

Give the children a length of string (100 cm), a weight and a stop clock or watch. Tell them to find the time it takes their pendulum to swing when it is 100 cm long etc. Graph their results, can they see a pattern?

Ask them to alter the length until it takes 1 second for 1 swing.

(ii) Weight

Give children a length of string (30 cm), a stop clock or watch and several weights. Tell children to measure the time it takes their pendulum to swing when they alter the weight. Can they see a pattern? It is important to remind the children of the work on variables so that when they alter the weight they do alter the length.

(iii) Swing

Give the children a length of string (30 cm), a weight and a stop clock or watch. Tell them to measure the time it takes the pendulum to swing when they alter the size of the swing. Again remind them of variables.

These lessons again lend themselves to a reporting session.

Refer children to the working of grandfather clocks etc.

A group of girls investigate the pendulum.

The Pendulum (background information for teacher)

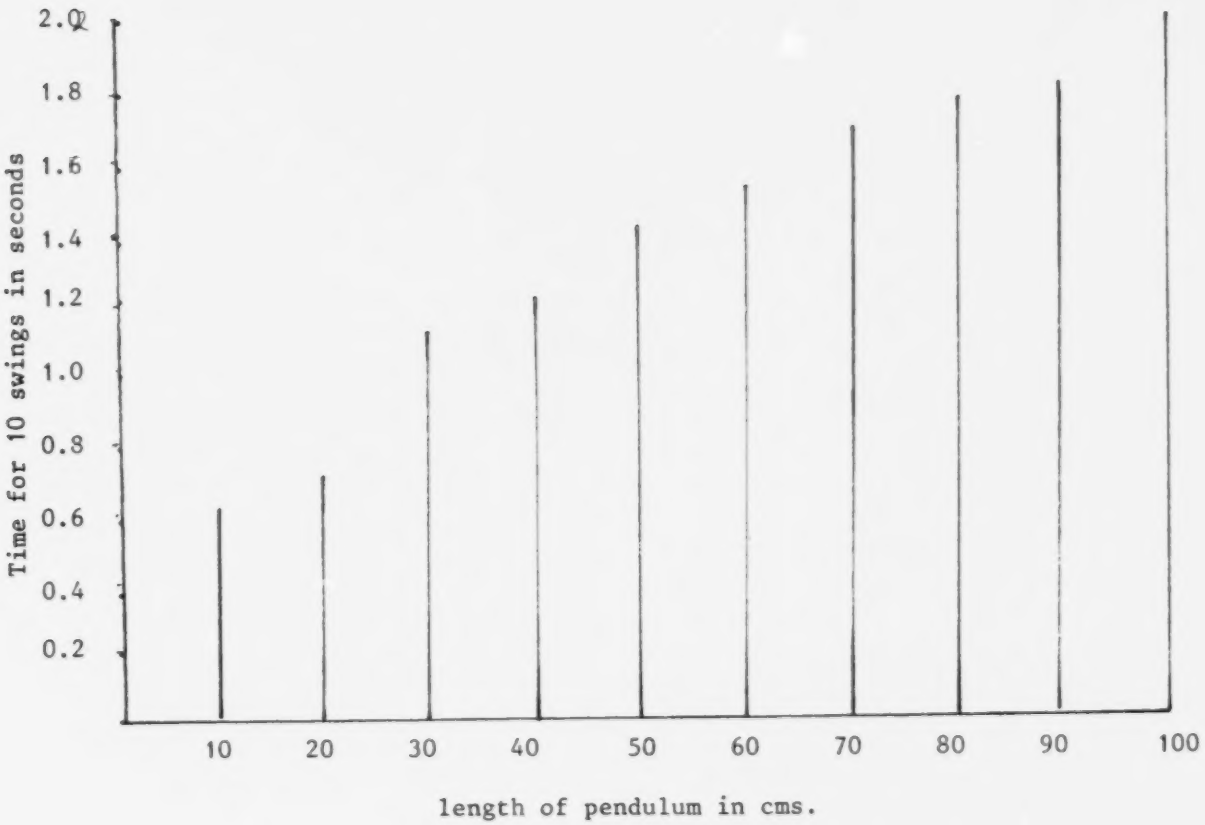
The time it takes a pendulum to swing is independent of its weight and the size of the swing (within limits)

The time is however dependent on the length of the pendulum. The actual relationship is quite complicated for most children in that the time is proportional to the square root of the length (i.e. if you increase the length 4 times you double the time).

This last statement has been made by children aged 11 who were at an advanced stage of development.

However it is more likely that children will conclude that "if you increase the length of a pendulum you increase the time it takes to swing and if you shorten the length of a pendulum you decrease the time it takes to swing".

Specimen results



Lesson 24 - History - 'My Family Tree'

Organisation - Class lesson followed by children working as individuals.

Introduce the children to the idea of a family tree by examining that of the Royal family or past kings or queens or refer to the book 'Roots' by Alex Haley.

Ask children to 'interview' their own parents and where possible grandparents before producing their own family tree.

The techniques of interviewing should be discussed and salient points noted by children before going home.

Lesson 25 - Science - 'Reaction time'

Organisation - Groups working at similar activities

(i) Give each group a 30 cm rule. Tell one child to hold the rule by one end with the other end between the open thumb and forefinger of another member of the group. Child drops the rule and the other catches it. The reading on the rule gives an indication of the child's reaction time. Repeat two or three times.

Make up a table and test all the members of the group.

The tests could be repeated using the other hand and patterns looked for.

(ii) Give each group a ball and a metre stick. Tell one child to hold the metre stick alongside the right leg of one of the group. Tell a third member of the group to drop the ball from a known height on to the foot of the person being tested. This person has to remove her foot before the ball hits it.
The ball is dropped from a lower and lower height until it hits the foot. The height from which the ball is dropped and hits the foot is a measure of the person's reaction time.

Test all members of the group.

Try using the other foot.

(iii) A comparison can be made between the results of (i) and (ii) by testing across the different groups. Again the children should be encouraged to look for patterns.

(iv) Can the different groups think of other ways of measuring a person's reaction time. Try these out.

(v) Ask groups to write down the names of as many different activities or occupations where quick reactions are necessary.

Reaction time - Pupil Sheet

1. Write down the kind of people who need to have quick reactions (e.g. boxers, hockey players, car drivers)

2. Here is a simple way to measure your reactions.

   Take a 30 cm rule and hold it at the 30 cm end. Ask a member of the group to place her thumb and forefinger 1 cm apart at either side of the 1 cm mark. When you let go of the rule she has to catch it as soon as possible. The reading on the rule gives a measure of her reaction time in cms. Repeat with other members of the group.

3. Do people's reaction times improve with practice?.

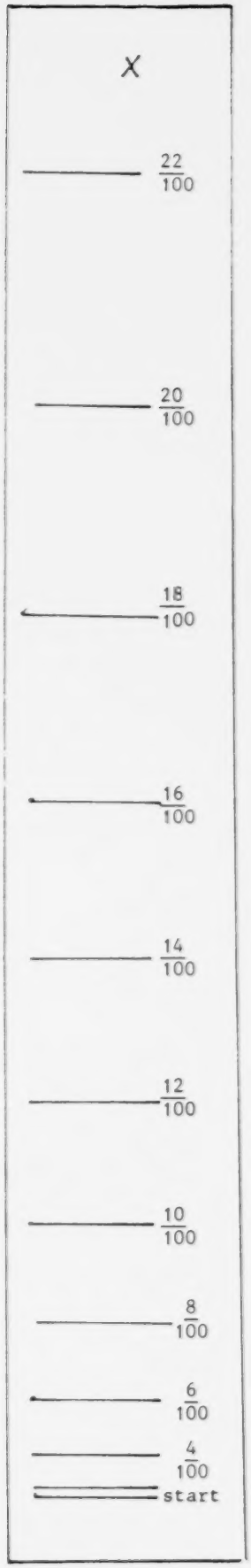
4. Try the members of the group using their other hand. Is there any difference?.

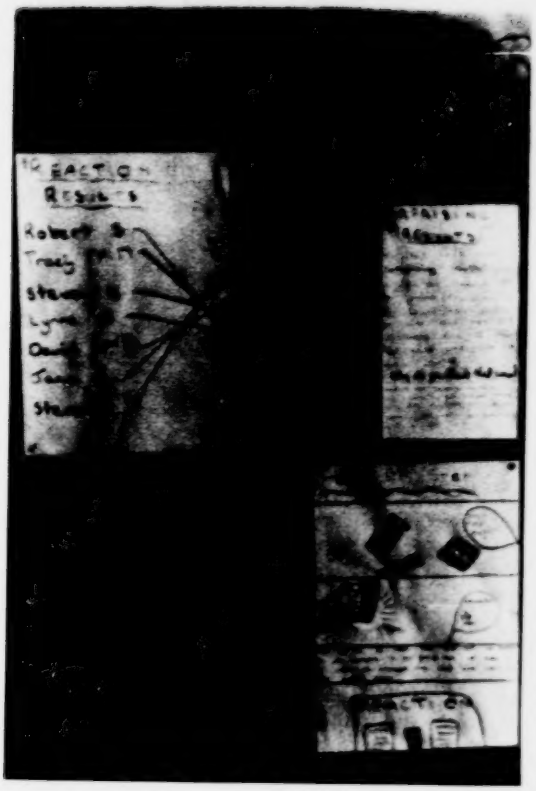
5. Try this at home with your mum, dad, brothers and sisters. Who has quickest reactions in your house?.

6. Copy the strip drawn alongside onto a piece of stiff card. You could use this to measure reaction time in 1/100 th of a second. Try this out.

7. Can you think of any other way that reaction time can be measured?.

8. What games do you play that require quick reactions?.





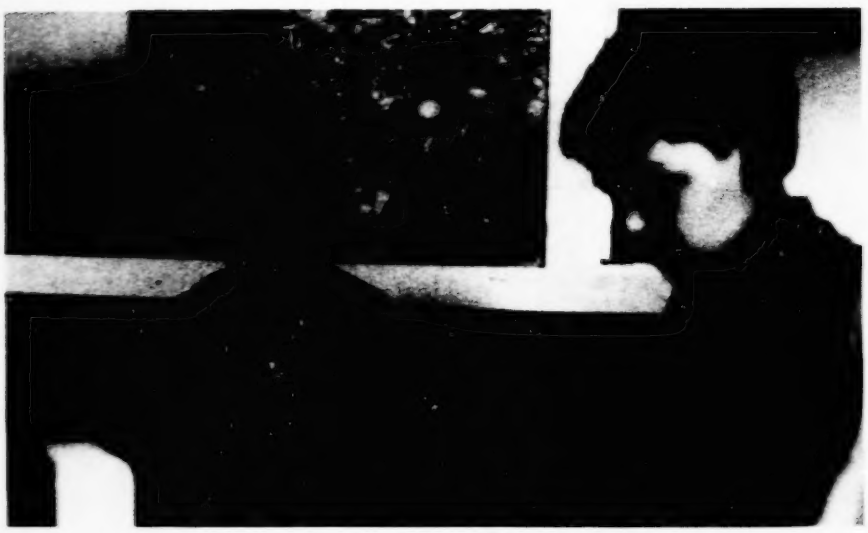
Reaction time chart.

Lesson 26 - Science / P.E. - 'Body Times'

Organisation - Children working in pairs or groups

(i) Tell one person in each pair to measure the pulse rate of her partner. Then ask the partner to walk round Gymnasium and measure pulse rate. Repeat after running round gym. and after exercises. Change over and measure the other person's pulse rate.

How long does it take for the pulse rate to return to normal?



James measures Fahad's pulse rate.

'TIME'

START:

FINISH:

SCIENCE & TECHNOLOGY LESSON

Group	Group/pupil names	SHADOW CLOCKS start	SHADOW CLOCKS complete	CANDLE CLOCKS start	CANDLE CLOCKS complete	SAND CLOCKS start	SAND CLOCKS complete	WATER CLOCKS start	WATER CLOCKS complete	DIAL WATER CLOCK start	DIAL WATER CLOCK complete	PENDULUM start	PENDULUM complete	REACTION TIME start	REACTION TIME complete	BODY TIMES start	BODY TIMES complete
A	FIONA B. JEAN P. GEORGE A. PETER A.			A/B	A/B	(i)/(ii)	(i)/(ii)	(i)/(ii)	(i)/(ii)	✓	✓	(i)/(ii)	(i)/(ii)				
B	FAHAD L. JAN G. JAMES T. MARY C.			A/B	A/B	(i)/(ii)	(i)/(ii)	(i)/(ii)	(i)/(ii)	✓	✓	(ii)/(i)	(ii)/(i)				
C	JOHN W. LINDA M. DAVID M'L RACHEL R.			A/B	A	(i)	(i)	(ii)	(ii)	✓	✓	(iii)	(iii)				
D	STEPHEN W. LIONEL R. CHRIS. G.			A	A	(ii)	(ii)	(ii)	(ii)	✓		(i)	(i)				
E	" "																
F	" "																
G	" "																
H	" "																

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Conclusion of project - 'A Science Fair'

A most satisfactory end point for this project is to hold a Science Fair.

The children could collect and display, possibly in school hall or classroom all their charts and in their groups all their investigations.

The first visitors could be children from other classes and the 'time' children would demonstrate and talk about their experiments describing what they did and what use they made of their appliances. If it is possible they could involve the visitors in some of the tests such as "how long do you think it will take you to write all letters of the alphabet?"

They could even test the reaction times and have a school competition. Are the reactions of 11 year olds better than those of 6 year olds?.

A parents' evening could be arranged and similar exercises carried out. No doubt the parents would be interested not only in the science work but also the work in other curricular areas associated with the project.

APPROACH 1

EXEMPLAR 2

An Integrated Approach - 'Materials'

APPROACH 1 SECOND EXEMPLAR

'Materials' was chosen as a topic as it -

a) is one of the four main areas of science suggested in PSDP Booklet 1 (the other three being 'Ourselves', 'Living Things and their Environment' and 'Energy Matters'),

b) is an area that tends to be neglected in primary schools,

c) is important since children are continually coming into contact with a great variety of different materials and there has been much concern about the misuse of the Earth's resources and the finite nature of many of these (more and more local authorities have special collections for paper and glass as part of a recycling policy).

PSDP Booklet 1 page 9 states -

"Materials

Early experience starts with materials such as sand and water in its various states. Children should have opportunities to investigate the similarities and differences among various materials (wood, paper, plastic, metals). This should involve measuring and sorting. Children should begin to appreciate the need to care for materials, e.g. polishing furniture, washing dishes, painting and preserving wood, oiling moving parts on bicycles. Pupils should have the opportunity to examine the physical environment. A study of buildings, for example, might include the way a building is made, the materials of which it is constructed (glass, brick, concrete block, wood, plaster-board, bitumen, lead, copper, polystyrene, PVC), the function of the different parts, ideas about strength and what services are needed. Model making in paper can lead to an understanding of shaping materials and the strength of structures. Typical topics may be bridges and flight. Opportunities should be taken to exploit the use of modern constructional toys."

Key Features of the Approach

As with all topics with a general title, there are many choices that the teacher must make -

A. Has the topic to be general and hence more superficial with regard to particular materials (Materials and their Uses)?

B. Has the topic to be specific and examine one material in detail (Plastic, Wood, Paper, Metals)?

C. Has the topic to be ecological and lean heavily on conservation (Wood, Biodegradable plastics etc.)?

What is most important at the primary stage is that the main emphasis in the science area of the curriculum must be to develop, through investigating the properties of materials, specific skills, techniques and attitudes and to give the children a variety of experiences through which they can build up concepts.

There are many pupil and teacher books and pupil workcard systems that include investigation of materials. Reference should be made to these and selections made of those most suited to the pupils concerned, again with regard to the school's policy for science.

PSDP Booklet 8 (Resources) could be useful at this point as it deals specifically with resources for both teachers and pupils as well as describing methods of organising these at school and classroom level.

For the purpose of this exemplar a specific material 'paper' has been selected for the following reasons -

1. It is readily available and inexpensive,
2. It offers a wide variety of cross curricular activities for the pupils,
3. It satisfies choices A and B above.

Outline of Methodology

The reader should apply the basic approach laid out in the previous topic 'Time'. The manner in which this topic is tackled, where the different curricular areas are to fit into a pattern will again depend not only on the experience of the teacher but also on the school's policies for all the curricular areas.

'A Study of Paper'

SCIENCE ACTIVITIES

STARTING POINT -

Collection of as many different kinds of paper as possible.
Have children sort these into different categories according to different criteria e.g. texture, size, colour, use, thickness, how easy it is to write on, smell, sound it makes when crumpled, how easily it tears etc.

From the above starting point can arise a great variety of practical activities. The activities suggested below are not in a hierarchical order, the actual choice and sequence is left to the teacher. She is in the best position to decide the stages of development of her pupils.

1. Size of paper -
   Ask children to measure the length and breadths of the whole sheets of paper from the collection.
   Are any of them standard sizes? (link with A4, A5, broadsheet, tabloid etc.)

2. Colour of paper -
   Ask the children to find out what happens to the coloured paper when it is submerged in water overnight. Is the colour 'fast'?
   Does adding detergent to the water have any effect?
   Children could try dyeing white paper using dyes made from natural substances such as lichens, onions, fruits etc.
   Investigate ways of making their dyes 'fast'.

3. Thickness of paper -
   Children could measure the thickness of different kinds of paper by taking 10, 20, 30 sheets and measuring the thickness of these in order to calculate the thickness of one sheet. They could make their own calipers for this purpose.

4. Uses of paper -
   Ask the children to write down as many uses as possible for paper.
   (writing, wrapping, tracing, drawing, typing, carrying articles as in paper bags etc.)
   Ask them to devise tests to find out the best paper for each use and to look for patterns.

5. Tearability of paper -

Ask children to find out which paper is the easiest to tear. (It is advisable to limit the number of different kinds of paper to be tested in order to avoid confusion)

Normally children will initially do this by hand and it may be that the teacher will have to suggest that fairer methods should be used. A discussion on variables will arise at this point and time must be devoted to this most important aspect of scientific investigations.

The children should be encouraged to devise their own tests.

Here are a few suggestions :

At the start of each ask the children to predict which one they think will tear most easily.

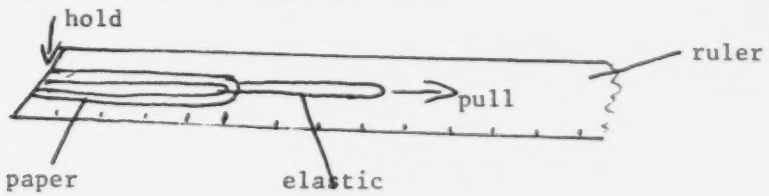
(i) Cut strips 1 cm by 10 cm from each sample paper to be tested.

Fold the strip over an elastic band and hold the loose ends at the end of a ruler.

Gently but steadily pull the elastic band until the paper tears. Note the reading on the ruler. Repeat and take average result.

Repeat for the other strips, remembering to use the same elastic band. Why?

Compare results with predictions.

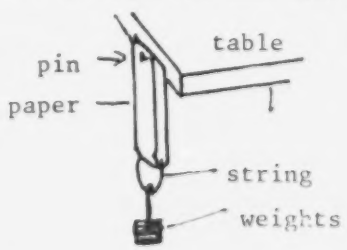


(ii) Cut strips of paper 5 cm by 10 cm from each sample to be tested.

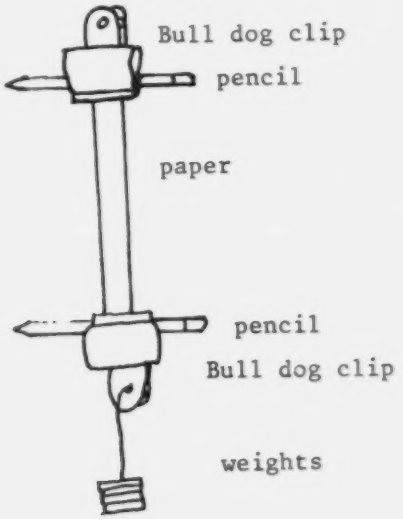
Fold the strip over a loop of string and pin the loose ends to the edge of a table.

Add weight to the string until the paper tears. Repeat and find the average weight needed to tear the paper.

Repeat for the other strips and compare results.



(iii) Cut strips of paper 2 cm by 10 cm from each sample to be tested. Fold one end of the strip over a pencil and hold it in a bulldog clip. Attach clip to a hook and fold other end round a pencil and hold using another clip.
Add weights to the lower clip until the paper tears. Repeat and find the average weight required to tear paper.
Repeat using other papers and compare results.



(iv) Try (i), (ii) and (iii) using strips of paper of same length but different widths. Does this affect tearability?

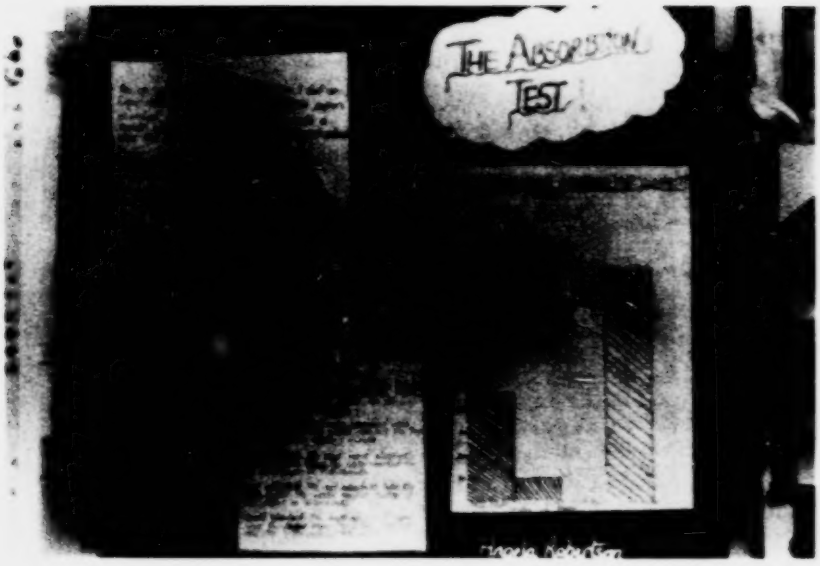
(v) Try (i), (ii), and (iii) using strips of same width but different lengths. Does this affect tearability?

6. Absorbency of paper -

(i) Cut strips of paper 3 cm by 10 cm from each sample to be tested. Pin one end of each to a long piece of wood and lay the wood across the top of a clear plastic tank. Add water to the tank until it is about 1 cm up each of the strips of paper. Compare the height that the water rises up each strip.

(ii) Lay 10 cm square pieces of paper across the top of a clear jar. Using a straw or dropper add water one drop at a time to the centre of the paper until the water drips through. Compare results.

The children could be asked to devise tests to find the strength of the wet paper. This could be further extended by drying the paper and testing its strength. Is there any difference between this and the original paper?



Example of child's chart on absorbency

7. Newspapers -

(i) Survey of pupils in class to find out what daily newspapers are read in their houses. Graph results. Could extend this to other classes.

(ii) Apply tearability tests from 5., but note take one newspaper only to begin with and compare its tearability across the print with up and down the print. Children will find that there is a difference. Ask them to tear the paper by hand, first across the print, then up and down the print. Ask them to examine the direction of the tear in each case and to look closely at the torn edge using a magnifier. What do they notice?
Children should be able to see the fibres that make up paper.
Which way do the fibres run?

(iii) Apply absorbency tests to the newspaper.

a) Drip ink or coloured water onto the surface of the paper.
What shape is the blot? Is it circular or oval? Why?

b) Cut strips of equal sizes from across and up and down the print.
Suspend these so that one end is in coloured water or ink.
How far up does the water / ink travel?
Is it the same in both cases? Why?

Tests (ii) and (iii) can lead on to how paper is made and the way the fibres run.

(iv) Try test (i) and (ii) with different newspapers. Are the results similar?
If samples of tabloid and broadsheet papers are used the children will discover that the results are reversed.
This again ties in with how the paper is made and then how it is used in the printing of the particular newspaper.
Ask the children to fold the broadsheet newspaper in half and they will see it is the same size as the tabloid newspaper.

8. Paper making -

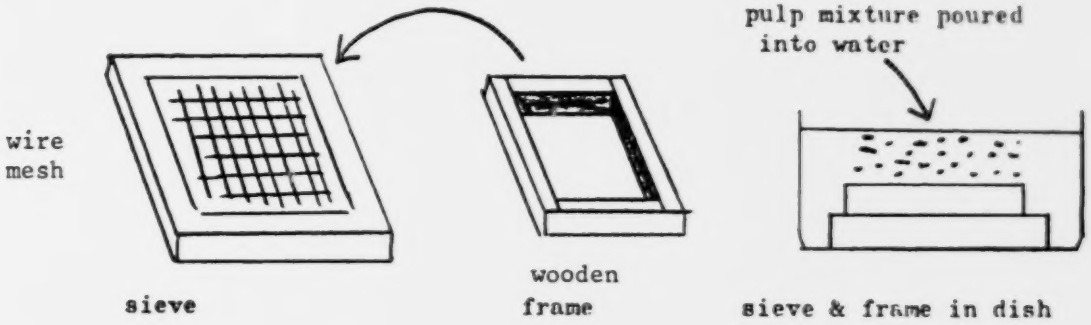
This is a natural follow on to previous lesson.
There are many books and pupil cards that give details of how to make paper from different scraps of paper torn into strips and left to soak or put in a liquidiser, before laying on a grid and pressed with felt.
Children can compare their recycled papers using a variety of methods.

Stages in paper making.

Making paper from scrap paper

Pupil Sheet

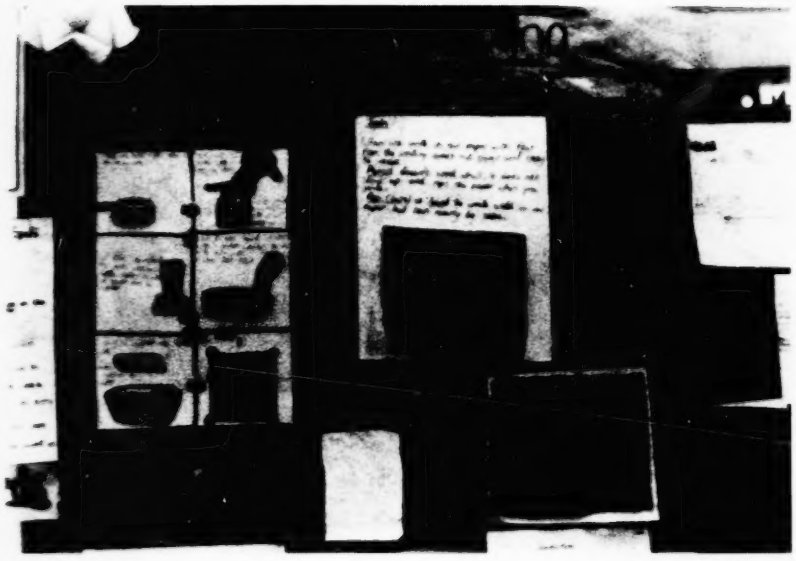
1. Tear the scrap paper into strips.
2. Steep the torn strips in water overnight.
3. Stir the pulp mixture thoroughly.
4. Add some Kaolin, so as to give the mixture a milky consistency.
5. Place the sieve and the frame in the dish as shown.



6. Pour the pulp mixture into the frame, trying to distribute it as evenly as possible.
7. Keeping the frame in position, lift the sieve out of the dish, and place it on the newspaper.
8. Remove the frame.
9. Place the felt on top of the pulp which is spread out on the frame, and then roll the felt firmly.
10. Lift the felt carefully. The pulp should adhere to it as a wet sheet.
11. Place the felt, with the pulp sheet uppermost, on the newspaper.
12. Carefully lift a corner of the pulp sheet from the felt, and peel off the whole sheet.
13. Lay the sheet out to dry.

Try writing, drawing on your paper using different types of pens and inks.

Which give the best results?



Paper making chart.

9. Litter -

This could be a topic in its own right with environmental implications. There are many ' litter packs ' available to schools which contain a great variety of associated activities.

Some suggestion :

(i) Collect litter from different areas in the playground or street. (use plastic gloves).
Do a count of the different kinds of paper found in each area. Compare results.

(ii) Relate the results from (i) to the positioning of litter bins. Are there sufficient bins? Are the used? Are they efficient? etc.

(iii) Draw a map of the area and mark in the 'black spots'.

10. Paper Structures -

Again there are many books and pupil card systems that cover this aspect well. The opportunities for children to devise their own investigations are many and varied. Problem solving and technology can also be well exploited.

Some suggestions :

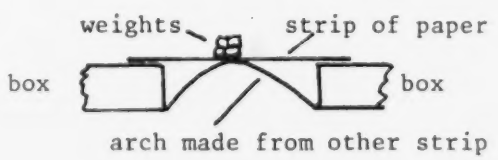
(i) Cut strips of paper and card 5 cm by 20 cm from the sample to be tested.
Take two boxes or bricks and place them 16 cm apart. Place each strip across gap with a 2cm overlap on each side.
Add weights (coins, counters etc.) to the centre of the strip until it collapses.
Repeat with the other strips and compare results.

(ii) Ask children if they can make their paper/card 'bridge' stronger.
Tell them to look closely at any bridges in their local area or refer to pictures in books.

Possible solutions -

a) Increase number of sheets. Do two sheets support twice the weight as one?

b) Arches -

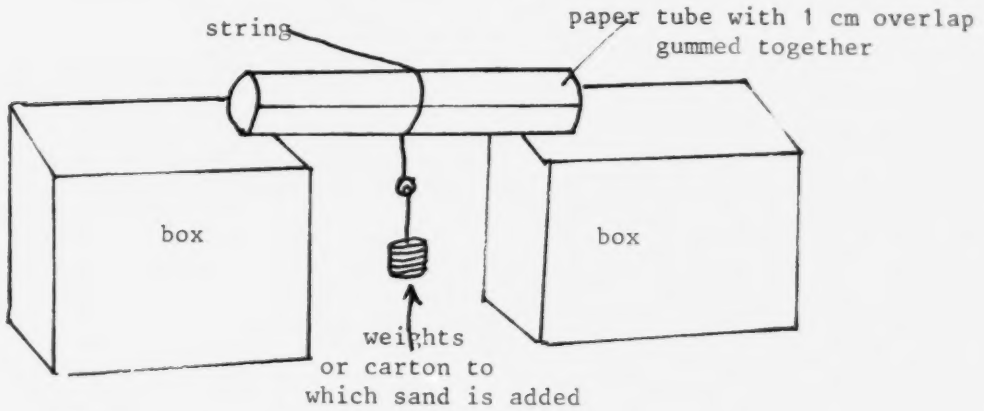


(ii) c) The children could try folding their sheets of paper into pleats and compare the folded one with the plain one. There are many possibilities here for open-ended investigations all involving design, technology and the principles of good scientific experience.

d) The pupils could move on to making paper girders and examine the effect of using these in their bridges.

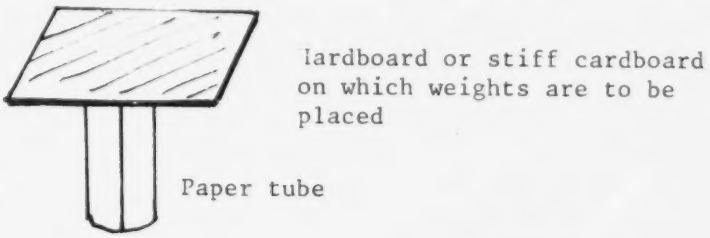
(iii) Strength of tubes is an other aspect of structures that lends itself to a variety of scientific and technological activities.

a) The pupils could be asked if they think that tubes make good structures and using sheets of paper of the same size make tubes of different lengths to compare their strength.



b) The effect of altering the diameter of the tube while keeping the length constant could also be investigated.

c) The same variables, investigated in a) and b) could be examined while testing the strength of tubes standing upright as shown below.



A good craft design and technology endpoint to paper structures would be to give the children twopieces of paper of standard sizes, sellotape and a pair of scissors and ask them to build a tower that will support a certain weight.

Other Areas of the Curriculum

LANGUAGE

The topic 'paper' could produce a great variety of language activities around the work on newspapers.
e.g. Analysing a local and national newspaper to compare the different aspects of 'news' covered - sport, fashion, gossip, politics, education, local, national, international, advertising, letters etc.

The children could produce their own class newspaper with different pupils given different jobs (roles to play) - editor with an editorial board, reporters (sport, fashion, class/school activities, local events). Interviewing techniques could be encouraged with children interviewing classmates, teachers, other children and local personalities.
A 'letters to the editor' feature would present an ideal opportunity to introduce and develop letter writing skills. This could start with letters about the newspaper itself and progress to letters on particular items that develop into a series of letters and replies encouraging the pupils present their views in a structured, concise form.
Advertising through the class newspaper again provides opportunities to write concisely but still give all the details required.

There are excellent opportunities for the use of microcomputers in putting the newspaper together with many of the skills and techniques of computer use exploited.
A 'Word Bank' could be compiled of words used to describe the different types of paper in the collection used in the starting point lesson. Words associated with 'paper' could be added to the 'bank' as the topic develops. Similarily a 'Phrase and Sayings Bank' of those associated with 'paper' could be constructed. (e.g. 'Paper tiger')

MATHEMATICS

As well as the weighing, estimating, measuring length etc. involved in the practical activities, there are many other mathematical skills that can be developed. While working with newspapers, the pupils could be comparing the relative sizes (areas) of tabloid and broadsheet papers as well as A4, A5 etc..
When the pupils are analysing the different aspects of 'news' covered in local and national newspapers in Language, they could be calculating the percentages of the different newspapers given over to each of the aspects being examined.

GEOGRAPHY

Link with countries that supply wood pulp for paper making
or select from newspaper a news item that will lead to the country to be studied.

HISTORY

A study of the history of paper making or the introduction of the printing press and life in those times could be undertaken.
or again use newspapers with specific news item to be the focus of the historical study.

It is, however, important that the integration of different curricular areas in this kind of approach is not artificial or haphazard. Forward planning is essential and there is always a wide range of news items from which to choose Geographical and Historical studies. The teacher must at all times keep in mind the school's policy in these curricular areas.

ART

Collage work using different papers.
Making models with papier mache.
Looking for water marks, collecting different examples.
Designing own water marks and using good quality paper reproduce these using pen and fine oil.
Wax-resistant pictures on paper.
Printing techniques applied to different types of paper.
Designing own wall paper patterns - for own room, room for a baby, old person etc.. What part will colour play in these different wall papers?
Advertising in class newspaper will lead to the importance of presentation (design and colour) in advertising. This not only leads to good original work with pupils producing their own adverts but also is useful in their presenting a display of adverts from magazines.
Displays can also be made from the labels of food packets and tins.
All of this, of course, links closely with language and use of language to describe articles. A lively discussion can result from an analysis of different adverts cut from magazines and newspapers as well as some excellent practical science and technology investigations.
(e.g. Is one particular washing powder 'better' than another? How could we find out for ourselves? etc.)

IMPLEMENTATION OF THIS STRATEGY

Applying the methodology mentioned on page 44 and the strategy for organisation detailed on pages 6 and 7, a sequence of lessons in the various curricular areas can be planned to fit the time being allocated to the topic. This will allow for a natural integration and a progressive development.

For example :

Lesson 1. - Introduction to topic.

Lesson 2. - Language:-Discussion on uses of paper and setting up of 'word bank'.

Lesson 3. - Science and Technology:-Size and thickness of paper.

Lesson 4. - Geography:-Country supplying pulp for paper making.

Lesson 5. - Art:-Collage using paper from collection.

Lesson 6. - Science and Technology:-Tearing paper.

Lesson 7. - Art:-Papier mache work.

Lesson 8.

and so on from the ideas previously suggested in the different curricular areas.

Conclusion -

It is important in all approaches of this kind that the work be monitored in a simple way throughout the school in all areas of the curriculum. Records must be kept and passed on not only to avoid unnecessary repetition but to ensure balance, breadth and progression.

No matter what theme/topic is tackled using the philosophy outlined earlier most of the curricular areas can be adequately covered in the development of an integrated approach. Science process skills are not unique to science, much of this work can arise out of other areas of the curriculum. As children (and adults) go through the normal day to day activities their experiences do not occur in separate 'subject' packages.
However as a recent DES report states "links are desirable but they should not become chains which restrict pupils' development in science"

APPROACH 2

EXEMPLAR 1

APPROACH 2 FIRST EXEMPLAR

PUPIL ROLE PLAY IN A DEVELOPING STORYLINE

(A) OUTLINE OF METHODOLOGY

General Approach

In this approach to interdisciplinary work the strategy used is to quickly involve the class in what is seen as an 'interesting and exciting' situation which pupils readily understand and associate themselves with. The pupils are placed in a geographical location at a set point in time and teacher tactics are employed to quickly absorb them in the situation described (eg in exemplar this is a request for young people to apply to undertake a space mission). Involvement is achieved by introducing special character sketches of important people involved in the introductory scenario and having each pupil take on the role of one of these characters or another character (themselves perhaps) who fits the development (eg in exemplar this could be the starship commander ; engineer ; nurse ; teenage settler .....) These chosen characters are faced with decision making and involvement at almost each stage of the storyline development.

As the theme progresses with the developing storyline, a degree of coherence is achieved because of the character involvement. The specific lessons in the different disciplines like language, geography, science and technology, health, P E., drama ..etc although essentially discrete become bonded to the story and the involved characters so that they become naturally integrated lessons. With each lesson there is meaningful pupil participation as 'involved characters' in the developing storyline. (eg in exemplar a drama lesson on 'Lift-off to Space' is a natural follow-on from basic science lessons on earth-moon and how rockets work)

The general approach can be applied to almost any situation which pupils can appreciate and understand (eg Columbus lands in America - pupils become Red Indians and/or Columbus's crew). It is , however, recommended that experience in trying the detailed exemplar (twice) be undertaken before attempting a new theme.

Finally, it must be stressed that all thematic work should be worked out in relation to school policy for the main curricular subjects (refer to Booklet 1 page 9). One important consideration, is to make sure that pupils do not become saturated by over exposure to ONE particular thematic strategy. A balance of approaches should be part of the school policy.

Interdisciplinary Theme Development

A detailed summary of the development or 'storyline' is prepared for the theme to be undertaken. The storyline progresses logically in time and pupils undertake aspects of the planned work using one of the teaching modes for classroom organisation (see pages 6 and 7) Care is taken to insure that the work scheduled can be undertaken within the allocated time. It is usual and recommended to allocate more class time at the start of an interdisciplinary theme so that pupils become involved and excited at events portrayed or pending. The introduction and initial scene setting is thus particularly important when planning the theme as are the attempts to encorporate traditional lessons from the broader curriculum into the storyline.

Monitoring of pupil practical performance in science and technology is built into the normal lessons set and does not require special testing procedures.

A simple system of pre- and post-testing can be carried out on scientific knowledge and grasp of simple concepts.

In conclusion, the approach essentially involves the use of traditional lessons which are introduced in a new, exciting and integrated fashion. A way which involves pupils in personal participation and interaction because they are characters deeply involved in the events which are unfolding. Role playing in a developing storyline, therefore, is the key strategy employed to achieve smooth integration in the various curricular disciplines.

Summary of Theme Development

The theme summary which follows should be considered as a teacher synopsis plan for the particular theme to be undertaken. It will be more readily understood when it is considered again in an expanded form with detailed teaching notes, lesson summaries and samples of pupil activity sheets.

Summary of Theme Development

EXEMPLAR : " JOURNEY TO AN UNKNOWN PLANET "

Storyline	Curricular Area	Lesson
1 Pre-testing & Monitoring	Records	1. Questions on aspects to be covered in theme.
2. Introduction	Language (o) Lang (writ)	1. Theme introduced - discussion. 2. Write letter of application.
3. Developing the theme.	Lang (oral) Lang (writ)	1. Design an application form 2. Fill and return form.
4. Characters in theme.	Lang (oral) Lang (oral) Lang (writ) Art/craft Lang (writ)	1. Experts and crew on space mission. 2. A simple biography. 3. Pupil character sketches. 4. Collage figures 5. Start "word bank" on space theme.
5. Selection of crew.	Drama PE - Health Technology Mathematics	1. Interviews - procedures. 2. Fitness and health tests 3. Ability at practical problem solving. 4. Number work - mental alertness.
6. Space base - mission control.	Geography Art	1. Location of buildings at Space Centre 2. Security checks - design an I D card.
7. Basic space training	History Science & Technology	1. Historical aspects of space. 2. Simple astronomy and basic space science.
8. Lift-off.	Science Craft/Techn. Poetry Drama Art	1. Rockets and gravity. 2. Cardboard rocket competition. 3. Sense poem. 4. "Lift off" costume class play. 5. Wall display - rocket.
9. Travel to the unknown planet.	Music Educ.Game	1. Music from "Space Odyssey" and "Planets" suite. 2. Interplanetary Travel Game.
10. Sighting the unknown planet.	Science Lang (o. and writ) Art	1. Telescope and binoculars - the lens. 2. What the planet looks like. 3. Painting or drawing of planet.
11. Landing and exploration.	Lang(oral) Technology	1. Landing on the planet. 2. Make and test a 'planet rover'.
12. End scenario.	Lang (o. & w.) Technology	1. Further exploration or return to earth or disaster. 2. Class competition on 11.2. Awards.
13. Post test.	Assessment END OF THEME	1. Test (possibly identical to 1.1) on science covered by all in the theme.

(B) TEACHING GUIDELINES AND DETAILS OF CLASS LESSONS

The details which follow expand on the summary of the theme development by giving detailed comments on the teaching tactics employed along with a selection of examples of class lesson material and pupil worksheets. The worksheets have been specially prepared for this UNESCO project submission and are based on extensive trials.

The science and technology work is emphasised and outlined in detail compared to the inputs from the other curricular areas. It is, however, necessary to expand on some of the key lessons (eg introduction) in language or craft or whatever so that the reader appreciates how the theme develops and, consequently, how the discrete lessons inter-relate and cohere naturally.

Pupil activities in science and technology are described and illustrated in full to enable trials of the approach to be more readily undertaken. References are sometimes made to the necessary teacher science background understanding required for guaranteed success in teaching the science. The scope of this work does not allow for detailed explanations on such background theory. In such cases the teacher is advised to consult 'standard texts'.

Theme implementation : special note

For the sake of clarity and to assist in school trials of this approach, the expanded details which follow are set out as follows :

(i) Teaching Guidelines - following the storyline sequentially with detailed teaching notes on each lesson in the section.

(ii) Lesson Details - following on immediately from the section to which they apply.

Set out in this fashion, it is a simple matter of examining each stage of the developing storyline and what is involved in terms of lessons and pupil resources.

TEACHING GUIDELINES

Storyline	Teaching notes
1. Pre-testing and Monitoring	Two aspects can be evaluated in this thematic work. (1) Ability in practical activites and problem solving situations. This is not pre-tested but reference should be made to any existing records for these types of experiences. Monitoring is carried out using simple record sheets for the practical work undertaken by pupils (individual/group/class) during the theme. These records give a guide to performance in the science and technology practical skills area. (2) Knowledge and understanding of aspects of work to be undertaken, particularly science content and concepts, can be assessed by simple pre- and post- questioning. See sample question sheet.

LESSON

" Journey to an Unknown Planet"

Teacher use

Theme

Questions

1. When was the first Sputnik sent into space?	1957
2. Why is Laika famous ?	First dog in space returned safely.
3. Who was the first man in space ?	Gargarin
4. Who was the first person to walk on the Moon ?	Neil Armstrong
5. When did this happen ?	1969
6. Name the largest planet in the Sun's family.	Jupiter
7. What planet has easily seen rings around it ?	Saturn
8. Which planet is farthest from the sun ?	Pluto
9. What is the name given to the sun's family of planets ?	Solar system
10. How often does the moon go round the earth in a year ?	12 (or 13) times
11. What instrument helps us see far away things?	telescope
12. What causes day and night ?	spin of earth
13. What is meant by "space re-entry".	return to earth
14. What does a parachute do ?	slows falling objects in atmos.
15. Write what the word SPACE looks like as seen in a mirror.	ƧbAƆE
16. What are asteroids ?	tiny planets in our solar system
17. What is a "Saturn V" ?	USA rocket
18. What causes a rocket to move ?	gas pushes one way -rocket moves the other
19. If the sun were the size of a football, would the earth be the size of a tennis ball or a marble or a grain of sand ?	grain of sand
20. What is a comet ?	large ball of burning gas.
21. Does the moon really change its shape ?	no
22. Name a star.	sun
23. Which planet is nearest the earth ?	venus
24. What is meant by 'orbit' ?	travel round
25. What is the name given to a person in a space ship ?	astronaut or cosmonaut
26. What is a lens ?	clear object used with light
27. Where can you find or see one ?	eye etc
28. A toy car is moving across the floor. Is its most likely speed 10 m/s or 10 cm/s ?	10 cm/s
29. Suggest a reason why astronauts cannot speak directly to one another outside the starship ?	spacesuits on or sound does not travel in vacuum.
30. Travelling to the moon is like going once round the earth or 10 times round or 1000 times round ?	10 times

If some of the above items are not covered by the class after completion of the theme, they can be readily omitted from the post-test.

Name .....

JOURNEY TO AN UNKNOWN PLANET

Answer Sheet

Pre-test : date _____		Post-test : date _____	
1	_____	1	_____
2	_____	2	_____
3	_____	3	_____
4	_____	4	_____
5	_____	5	_____
6	_____	6	_____
7	_____	7	_____
8	_____	8	_____
9	_____	9	_____
10	_____	10	_____
11	_____	11	_____
12	_____	12	_____
13	_____	13	_____
14	_____	14	_____
15	_____	15	_____
16	_____	16	_____
17	_____	17	_____
18	_____	18	_____
19	_____	19	_____
20	_____	20	_____
21	_____	21	_____
22	_____	22	_____
23	_____	23	_____
24	_____	24	_____
25	_____	25	_____
26	_____	26	_____
27	_____	27	_____
28	_____	28	_____
29	_____	29	_____
30	_____	30	_____

SCIENCE & TECHNOLOGY MONITORING SHEET

TOPIC HEADING	START:	END:	SCIENCE OR TECHNOLOGY LESSON Source / reference	No	Group/pupil names											
					start											
					complete											
					start											
					complete											
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Copy the above sheet for the theme chosen .
Record pupil/group completion against relevant activity.
Copy of final record to go to head teacher for class records.

See page 79 for completed exemplar.

TEACHING GUIDELINES

Storyline | Teaching notes

2 Introduction.

2.1 Theme introduced

Pupils introduced to the theme by a class lesson based on a letter 'just received' (fictitious) by the headteacher
Young pupils sometimes believe details given this way but this is unlikely in this theme.
Oral discussion on the text of the letter.

2.2 Response by class

Oral discussion leads to a traditional language lesson on writing a letter.
A discussion on the letters written leads to a class response letter which is to be sent off to the university. The letter essentially should request application forms.

NEW SPACE PROJECT WINS INTERNATIONAL APPROVAL

Until now space travel has been very much for EXPERTS only but a new scheme has been announced in which a limited number of young people will be given the opportunity to join an expedition which plans to explore the depths of the Universe.

In charge of this expedition is Professor Gregor P Lavalle an experienced astronaut now director of the Institute of Interstellar Research at the University of Strathpeak. At a recent conference Professor Lavalle said :

"The wonders of space travel should be available to all. The future of the human race may depend on our ability to adapt to new environments deep in space."

If you are interested in applying to become a member of the expedition please write to the Secretary, University of Strathpeak, Glasgow G1 U 2, Scotland.

Storyline | Teaching notes

3. Developing the Theme

3.1 Discuss the design of application form

Oral work with class in which you draw out the various aspects set out in an application form. The layout of the form is built up by questioning

3.2 Individual pupil returns

Pupils are presented with the actual form just received from the Universitv. This is discussed by comparison with the class version 3.1. Pupils complete and submit the form for 'sending off'. See lesson 3.2.

3.2 LESSON To be issued to each pupil.

U N I V E R S I T Y O F S T R A T H P E A K

APPLICATION FORM

Project applied for : .....

1. Name ..... Age ..... Sex ....

   Address .....

   ....

   photo

2. Education School attended .....

   Subjects 1 ... . 2 ..... 3 .....

   4 ..... 5 ..... 6 .....

3. Personal Details

   Height _____ Weight _____

   Innoculations 1 _____ 2 _____

   Illnesses 1 _____ 2 _____

   Injuries 1 _____ 2 _____

4. Personal Background : write briefly about hobbies, interests and sporting activities ...

5. Reasons for wishing to join the space expedition

   (1)

   (2)

6. Declaration

   I declare that to the best of my knowledge and belief all the answers above are true.

Storyline | Teaching Notes

4. Characters in theme.

4.1 Experts and crew

Language lesson (oral) in which a discussion takes place on likely characters involved in a space mission.
Who will be in charge ?
What special skills are needed for a long space flight ?
Can we manage on our own or are some experts required ?
Further questioning leads to pupils suggesting the specialists needed (doctor, engineer, computer expert food scientist and so on) rather than a list being presented to them.

4.2 Simple biography — See lesson 4.2.

Language lesson on how to set out a simple biography for a person. Leads directly to reading model biographies.

4.3 Character descriptions

Issue the sheet on descriptions of the "experts".
Discussion leads to pupils identifying the key features in the brief character sketches - details on qualifications background, experience etc. This reinforces 4.2 and links with application form lesson.
The importance of a photograph can be stressed. Gives physical picture of the person and 'hints' at personality.

Pupils are now allowed to select a character they wish to be on the mission (themselves, parent, film star etc). Some are allocated or asked to 'pretend' that they are one of the experts.
Each pupil now writes a short character desription of who they are on the mission (no photographs atthis stage).

4.4 Collage figures

Each pupil produces a simple collage figure within an A4 size piece of card of the character chosen.
The production and display of these figures has a big impact on pupils. They see their figure as part of the team on the mission. Impressions on personality come out (big, fat, happy etc).
The completed cut out figures are pinned to the wall or display board with their names and titles below (eg Professor G P Lavalle - Team Leader .....)

When characters become involved in the storylie they should be moved from the group (eg four selected to descend to the unknown planet for initial survey they leave the rocket outline and are set on the unknown planet model or wall outline.

4.5 Word banks

Start a list of space words on a wall display board (some teachers have pupils build up a words diary for the theme). Use the method you think best.

Words : experts : crew : space ; expedition ; interstellar

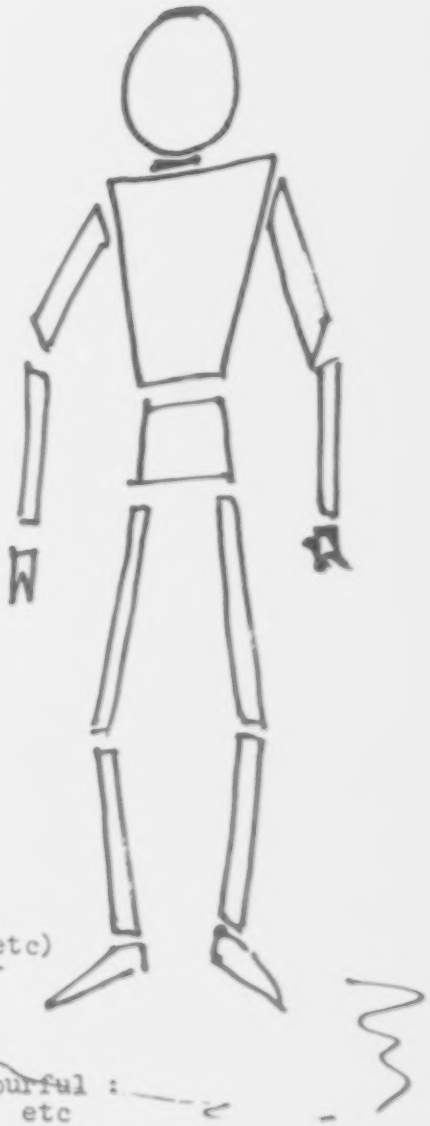
4.2 **LESSON** Teacher (aspects to be drawn from class or discuss)

Make up of a simple BIOGRAPHY

What aspects do we require to know about someone in order to make up a simple biography ?

The following list of aspects should be obtained from careful questioning of the class.

Build up a summary of the key features on the board.



NAME

AGE

SEX

LOOKS or PHYSICAL APPEARANCE

This is an important element an should be analysed in more detail so that pupils will become more observant and competent in describing people.

"FACE" : hair ; nose ; eyes ; ears ; mouth ; teeth ; chin etc
Comments on 'colour', 'shape' 'texture' etc

"BODY" : build (slight - heavy etc)
carriage
stature
and so on

"CLOTHES" : uniform ; tidy ; colourful : dirty ; fashionable etc

PERSONALITY : friendly ; happy ; forceful etc

Is this a likeable person or not ? What is your reason for saying this ? Are there several reasons ? Are there unknown factors ?

BACKGROUND Where born ? Lives ? Experience ? Interests ?

Reasons for considering the person.

Note that many of these points can be related to previous lessons (eg application form filling) and can be considered as pupil reinforcement of work covered in part.

Simple biographies for the EXPERTS

Professor Gregor P Lavalle

Director of the Institute of Interstellar Research at the University of Strathpeak.
B.Sc. (honours) in mathematics and astronomy
Ph.D. in earth sciences.
The professor has extensive experience in the technology of space. He has taken part in several space probe missions including a flight to the moon. He has spent several months in a space laboratory.
Age: 39 Married with three daughters.

Dr. Marjory Roganoff

Personal assistant to Professor Lavalle and space mission organiser.
M.Sc. in mathematics and economics
B.A. in personnel administration .
Speaks fluent French, Russian and English.
She is the widow of a Russian cosmanaut killed in a splashdown disaster. She has recently submitted a doctoral thesis on the effects of space flight on personality.
Age: 40 Widow with no children.

Mike Masterton

Captain of the mission starship. He has a first class degree in astronomy. He is an outstanding athlete and an Olympic gold medallist in the Decathalon.
Previous experience as an astronaut includes service on a space lab and several flights to the moon.
This will be his first major flight beyond the moon.
Age : 32 Single

Major Robert Macleod (known as 'Mac')

Navigator and computer engineer. Started his career as an apprentice in the air force before going on to take an honours degree in physics and computing.
Very experienced in rockets and missiles. ON loan to the mission team from US air force.
Age : 32 Single

Dr. Angie Stillwell

Medical officer. She is experienced in the biology of space . Interested in studying the effects of prolonged space flight on the human body.
Age : 28 Single

Archie Maxwell

Systems engineer. He studied first in Scotland and then in the USA and USSR. Author of several books on space technology.
Age : 38 Married with five children

LESSON

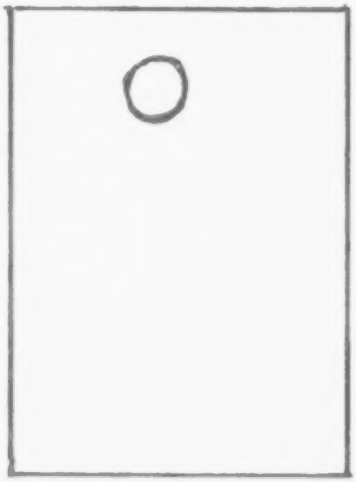
To be carried out by each pupil

Teacher instructions on how pupils make a COLLAGE FIGURE

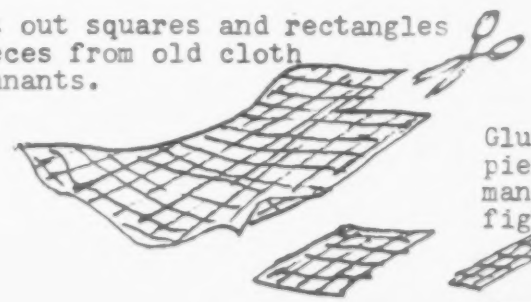
See the photograph opposite of the collage figure made by a pupil for Professor Lavalle.

Issue blank sheet of A4 thin card or sugar paper. This confines size of figure.

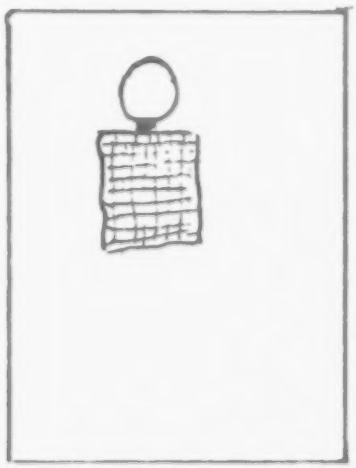
Pupils draw a circle for the head.



Cut out squares and rectangles pieces from old cloth remnants.



Glue (copydex) pieces to make man or woman figure.



Use string or wool for hair and ornamentation.

Fix cloth belt over hip joins and cut out the figure.

Figure can be given items to hold.

John Smith - settler

Collage figure made by pupil on A4 size sugar paper

S toryline | Teaching notes

5. Selection of the Crew

5.1 Interviews - procedures

Oral work involving a team of three pupils drawing up questions to be asked to each applicant. The team can be rotated and the entire lesson can be dramatised when candidates enter singly on to a stage and sit before the interviewing panel. Another class in the school (or some of the actual class) sit in to observe what happens.
The procedure can involve part or all of the class undertaking the theme. Applicants should be allowed to ask questions of the panel. The panel team should be changed after a while.

5.2 Fitness and health tests

All applicants are deemed to have 'passed' the interview. They then proceed to the next stage which assesses their mental and physical fitness and alertness. This involves essentially a lesson in the gym using the facilities available and a clock. Teachers can readily devise variations and improvements on the activities suggested.
Scores or performance attainments are entered in the "Space Selection Tests Record Sheet" issued to each pupil.

5.3 Ability at practical problem solving

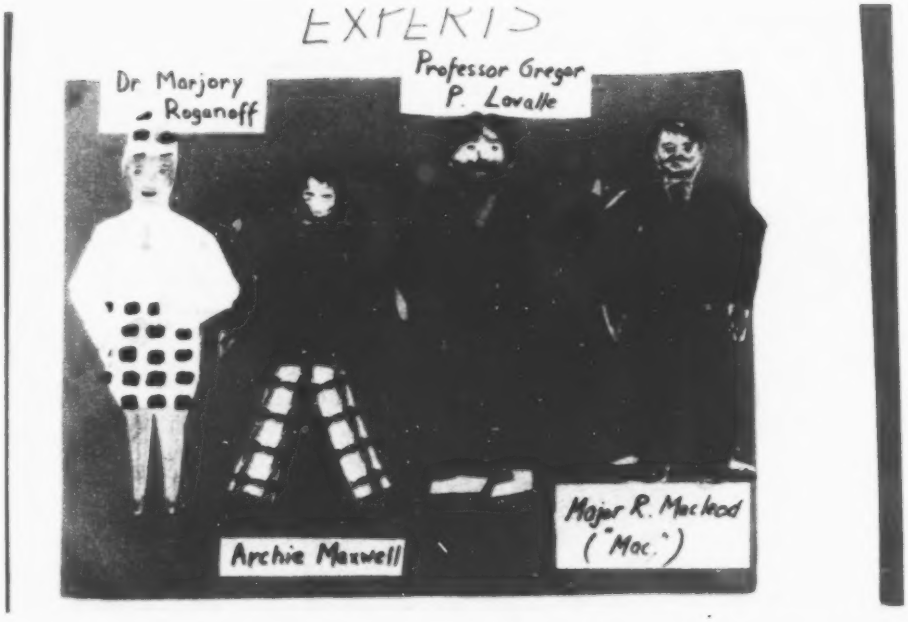
Two tests are given against the clock. This allows for all pupils to have what is seen as a 'fair test'. A variety of other problems to those suggested can be given. The two selected are easily resourced, vary in what they demand and are fun to do. Pupils also readily understand what is to be done within the set time. viz :

Mirror game : difficult to do as it involves looking at the reflected image of the pencil movements. The idea behind the activity is that the crew will be travelling into the unknown - new laws of science may apply and they (crew) must be able to adapt. This game changes the laws of seeing. How well did they adapt?

Engine sabotage problem - how ingenious can each pupil be using a few simple items to remove the three items from the bottle.

5.4 Number work - mental alertness

Standard mathematics or arithmetic test (based on child) using the on-going scheme of work material.



Collage figures of the Experts and Crew made by pupils

5.2 5.3 and 5.4 LESSONS Record sheet kept by each pupil.

SPACE SELECTION TESTS

Name .....

1. STAMINA : 5 points for each item (maximum)

Squat thrusts -	in 60s did	____	Pts	____
Press-ups -	in 60s did	____	Pts	____
Skipping -	did	____	Pts	____
Obstacle course-	completed	____s	Pts	____
		Total (1)		____

2. SKILL : 5 points for each item (maximum)

Bat and ball -	did	____	Pts	____
Baskets (from 10)-	in	____	Pts	____
Bean bags in pail-	in	____	Pts	____
Dribble -	time	____s	Pts	____
		Total (2)		____

3. BODY CO-ORDINATION

Movement and dance to music (10 points)

Total (3) ____

4. DEXTERITY

Mirror game flight path (amount completed in set time with deduction for faults) - 20 points maximum.

Total (4) ____

5. DESIGN INNOVATION

Technology problem of removing 'sabotage' items from delicate machinery. - 20 points maximum (for success in set time)

Total (5) ____

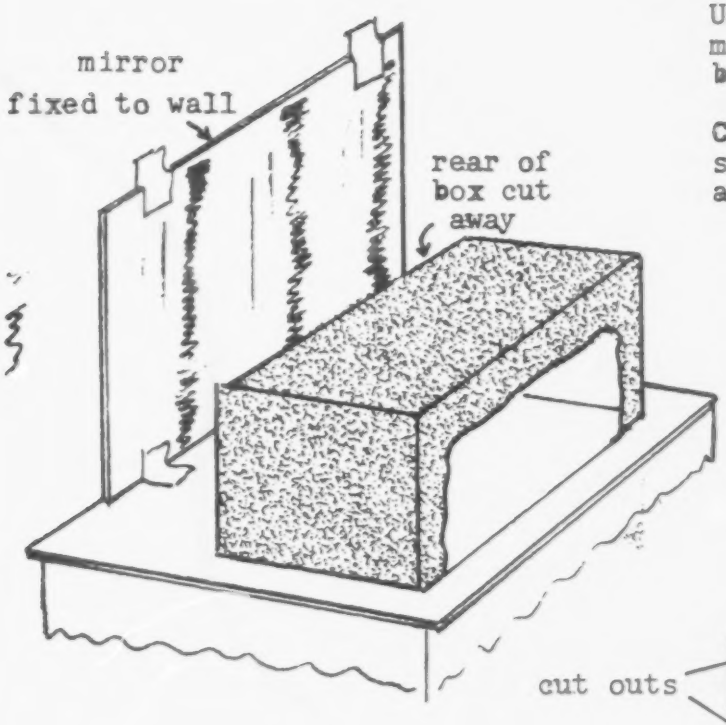
6. MENTAL ALERTNESS

Mathematics or arithmetic test (10 points)

Total (6) ____

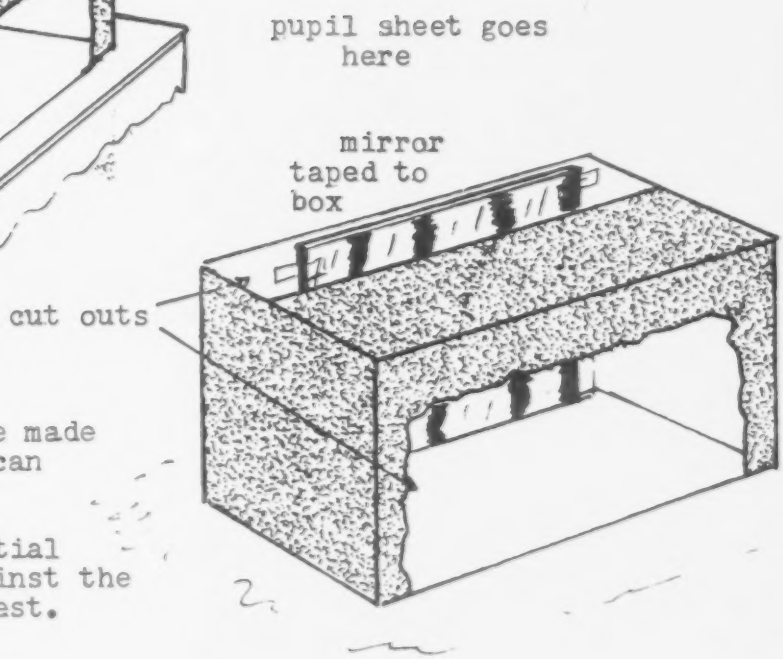
FINAL SCORE ____%

DEXTERITY TEST : Mirror Game



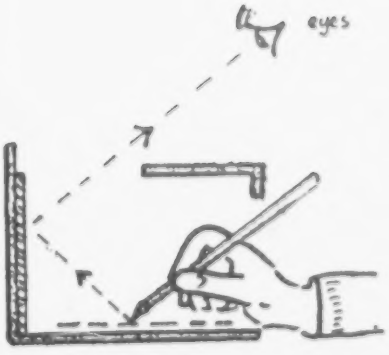
Use an old piece of flat mirror and a large cardboard box or carton.

Cut the box in one of the ways shown and fix the mirror upright as indicated in the drawings.



Two mirror games should be made so that the entire class can quickly try the activity.

Most children wish an initial try and then a 'test' against the clock. Do as you think best.



Pupils should be shown how to insert their sheet into the box and instructed that they must look at their hand IN THE MIRROR.

Make sure they can NOT see the sheet directly.

Marks are given for distance gone (in 3 minutes say) with 1 point off EACH time the pencil crosses out of the path.

The rules can be modified as you see fit.

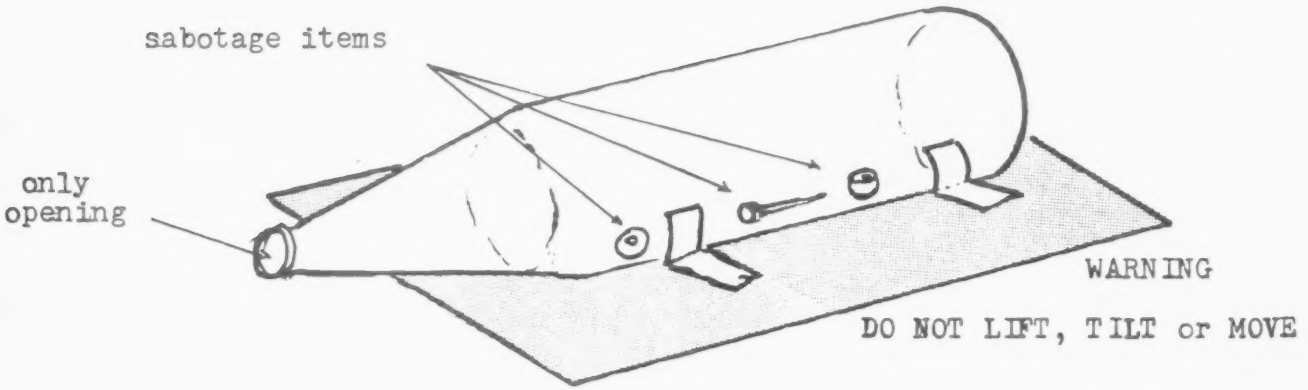
5.3 LESSON Sheet for EACH pupil.

DEXTERITY TEST : Mirror Game

93

94

DESIGN INNOVATION : Engine Sabotage Problem
rocket engine pump unit



Problem

The special pump unit has had three small items dropped into its workings (an iron nail, a marble and a small bead).

These will cause a lot of damage if the pump is switched on.

You are to devise ways of removing these items using the materials supplied and NOTHING ELSE. You must NOT move, tilt or lift the pump unit in any way. You are not allowed to make holes in it.

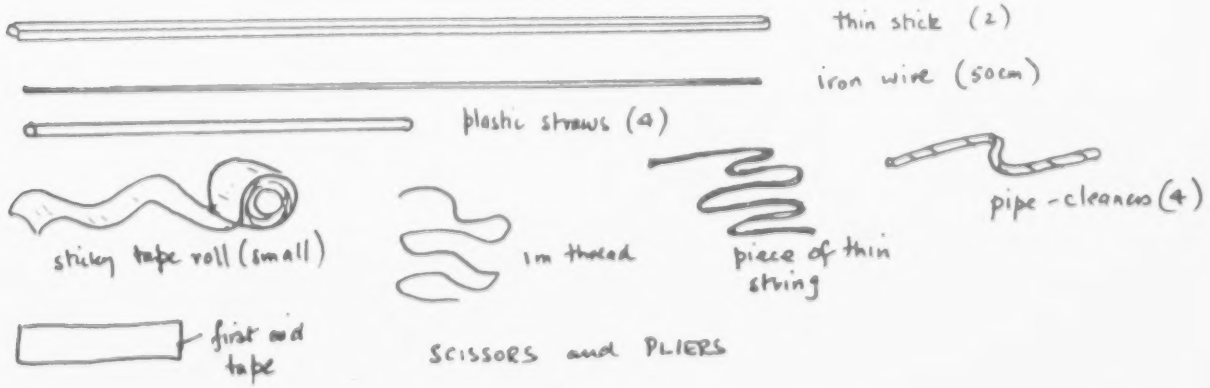
Devise as many ways as you can to remove the items.

Show your teacher how the gadget you have devised can remove the object. You get full points if you can remove all three items inside 3 minutes with only ONE gadget you have made.

Keep your ideas SECRET. Let others in the crew think of their own ideas.

Materials

Your teacher will give you a pack of materials for use in making your gadgets.



Storyline | Teaching notes

6. Space base - mission control.

6.1. Location of buildings at Space Centre

Basic geography lesson on drawing a plan view - in this case of the space base site. Requires that previous experiences of this type of work be reviewed.
Pupils should 'suggest' some of the various buildings that will feature at the base. What is their likely location ?
Discussion should lead to a possible plan.
Some points likely to emerge are :
(i) Launching pad : how near to other buildings ?
(ii) Mission control
(iii) Laboratories : safety precautions ?
(iv) Living quarters : Health facilities : Parking Recreational area.
(v) Power unit : lighting and communications.

A large wall outline could be built up and labelled. Buildings could be colour coded.

6.2. Security checks

A natural extension from 6.1 is to introduce a security system (perimeter fence ; gates ; a warning alarm system). Changes can be made to the wall plan. Reference can be made to the technology "sabotage" problem 5.3 and the "need to take care". This can lead directly to references in the current NEWS of hijacking etc

The lesson develops to the need to possess a 'security check pass' (code words - finger prints- photographs - tatoo marks etc)

The work is finished by an Art/craft lesson on designing and producing a simple but effective I D card. (all pupils to possess one as part of the role play development). Use cuttings of people from newspapers in place of personal photographs.

SPECIAL TEACHING NOTE

A three dimensional table model of the space base is to be preferred to the wall plan. This requires more time and classroom space. The science and technology lessons to follow, however, can be related to the real model (Fit a warning alarm system : Fit perimeter lighting ; Make a working lift-off pad etc) If the time is limited (8 weeks say) then in a first trial of the approach it is recommended that a wall frieze only be made.

Storyline | Teaching notes

7. Basic Space Training

7.1. Historical Aspects of Space

Pupils are given two or three history lessons on important space exploits (rockets in ancient China ; 1926 Goddard's first ever liquid-fuel rocket ; 1942 V-2 rockets in second world war ; 1957 Sputnik 1 ; 1957 Sputnik 2 with first live animal in orbit ; 1961 Vostok 1 with Yuri Gargarin the first man in orbit ; 1963 Vostok 6 with first woman (Valentina Tereshkova) in space ; 1969 Apollo 11 with astronauts Neil Armstrong and Edwin Aldrin the first men to land on the Moon .....)

Details and photographs/slides/tapes can be readily obtained.

7.2 Basic Space Training

This section allows for a major input of science and technology to the thematic study.
The crew require full information on the basic scientific knowledge involved with the mission. This requires simple astronomy lessons and a programme in basic science and technology associated with the mission. Pupils see the logic in this regular science programme.
At this stage the teacher should consult her/his basic core programme in science for the session (see P S D P note on page 3) and extract suitable science/astronomy lessons for use now in the theme. Additional lessons for group work or whole/part class must also be selected from resources available. The record monitoring sheet should be kept (refer Section 1.0 page 63). A sample record sheet, based on school trials, is given on the next page.
When a school does not have a set programme of science for the year then the series of lessons selected are recorded for purposes of being the 'science programme' for the class. The records in this case must be passed to the head teacher for policy purposes and will be needed by future class teachers.

Pupils will be grouped according to the method normally used by the class teacher and will undertake several of the activities over a 3 or 4 week period using one of the classroom organisational strategies outlined in P S D P notes (pages 6 and 7).

JOURNEY TO AN UNKNOWN PLANET

START:

END:

SCIENCE OR TECHNOLOGY LESSON Source /reference		"SUN-EARTH - MOON" CORE LESSON Sc. A		"PHASES OF THE MOON" GROUP Sc B		"ARRIVATES" GROUP Sc C		"SPACE PROBE PROBLEM" GROUP TECH D		"SOLAR SYSTEM" CORE LESSON Sc. E		"WARNING INDICATOR" GROUP TECH F		"BALLOON ROCKET DESIGN" GROUP TECH G		"STARS AND CONSTELLATIONS" CORE LESSON Sc. H	
No.	Group/pupil names	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete	start	complete
1.	ANN A JOHN B TOM C			✓		✓	✓					✓	✓				
2.	RICHARD D GERRY S GEORGE T.			✓	✓			✓						✓	✓		
3.	SIMON X JEAN Y MARJORY Z			✓	✓	✓	✓					✓					
4.	LINDA P LIAM R ELIZABETH S					✓		✓	✓					✓	✓		
5	..																
6	..																
7	..																
8	..																
9	..																
10	..																

ALL

ALL

ALL

SOLUTIONS AND SPECIAL TEACHING NOTES FOR SCIENCE AND TECHNOLOGY LESSONS

The following brief comments will assist in the carrying out of the pupil lessons which follow :

Lesson A

Initial lesson is very basic involving pupil interaction to a demonstration where important space words are introduced and knowledge covered. Important concepts are the vastness and emptyness of space and the relative insignificance of earth.

Pupil work involves important process skills (using materials, reading scales, working with numbers, making a scale model) The final models should, in theory, all be identical in size with the thread distance similar throughout. In practice the results show startling variations. Gives rise to a nice lesson on "reasons for the differences" - practical errors due to incorrect readings, use of ruler scale, arithmetic error ...

Lesson B

Refer to standard texts for 'phases of the moon'.
Pupils should be encouraged to use the moon shapes from the dailly newspaper or from a diary.
A demonstration lesson with a torch and a tennis ball can nicely illustrate the phases as a conclusion at the final reporting session.

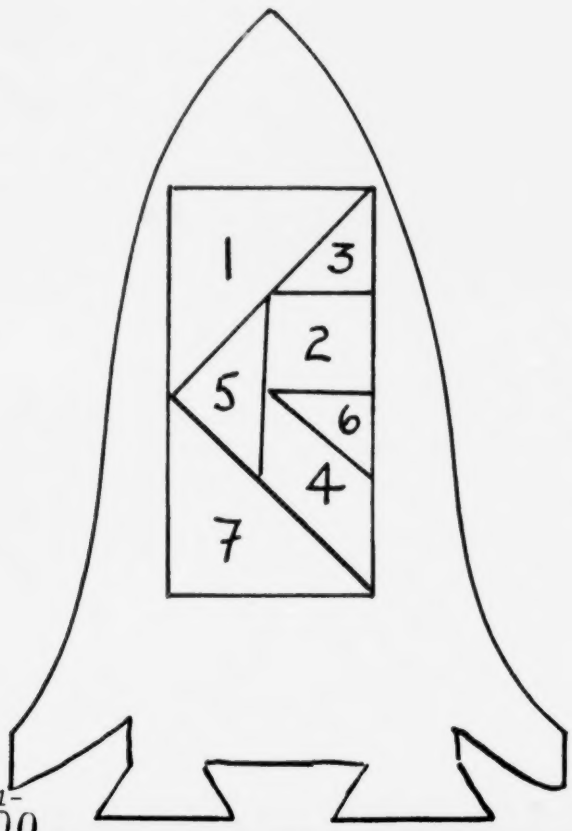
Lesson C

The basic science involved in this lesson is that of air and its resistance to objects which move through it (air friction). The parachute has a large area and experiences a big resistance to the falling module (examples in life : spacecraft re-entry ; fruit dispersal ; jet planes landing on an aircraft carrier ..)

Lesson D

This is essentially a simple mathematical tangram puzzle.

The solution is as shown.



Lesson E

Important space language is re-inforced and a knowledge of the solar system developed.

Again the difficult concept of the vastness and emptyness of space is repeated .

Lesson F

This is an adaptation of the activity given in the technology for the primary school series "Starting Technology" . The main feature of a technology input is that it involves pupils with design innovation. Many valid solutions are possible to any problem set.
A selection of possible solutions from 'Starting Technology' have been given on the next page by permission of the copyright holders. The solutions relate completely to this lesson and are given to assist the reader in what to hope for by way of solutions.

Lesson G

Many solutions are possible in making a balloon rocket.

Performance is affected by repeated use of the balloons.
New sausage shaped balloons work well.

Lesson H

The lesson allows for further repetition and extension of simple space words. Pupils have thus become familiar with all the aspects of space they are likely to need in the journey to the unknown planet (moon, planet, orbit, sol ar system, stars, galaxy, meteor, comet, gravity, constellation, ...)

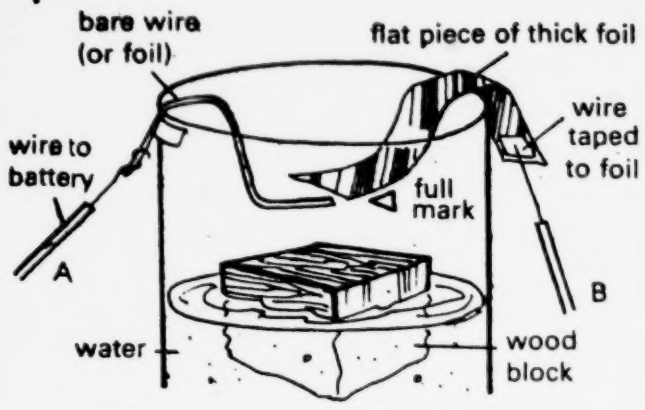
These lessons are vital for understanding of the mission. Language work in the science and technology area will greatly assist understanding and performance in the reading and oral work which follows.

.....

LESSON F : Solutions and ideas for teacher use.
Taken from "Starting Technology" Book 2 by G. Mills and J. Aitken by permission .

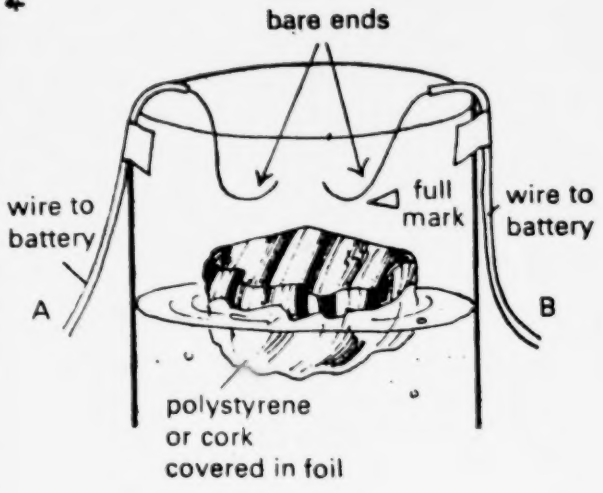
4.2 IDEAS FOR SWITCHES

1



When the water rises it makes the block _____?

2



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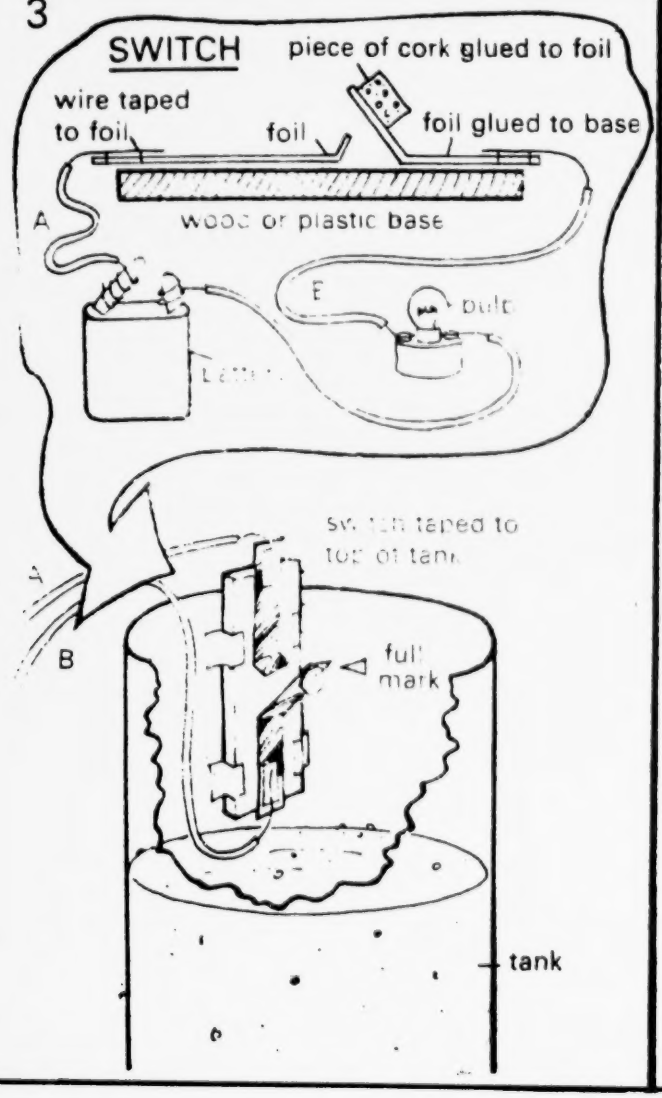

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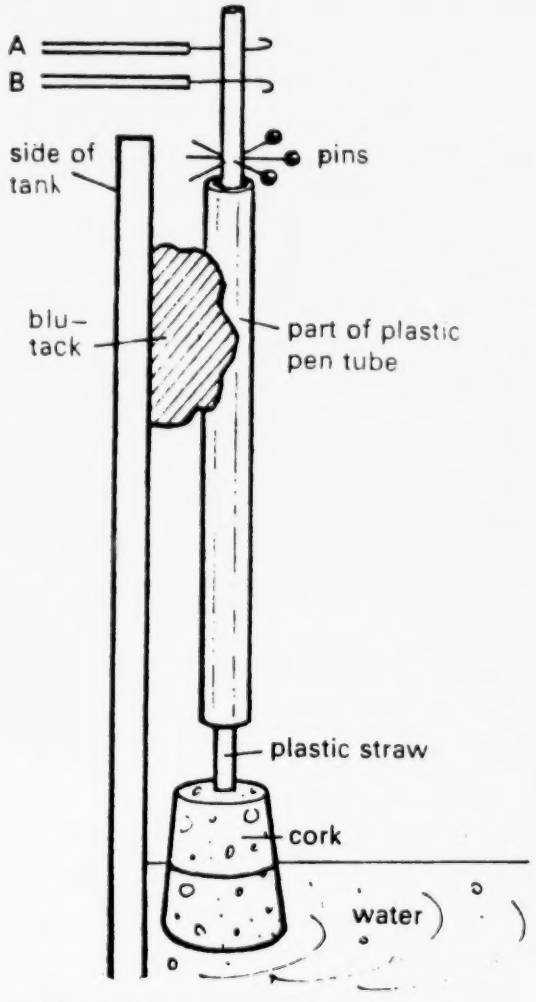

How does the switch work?

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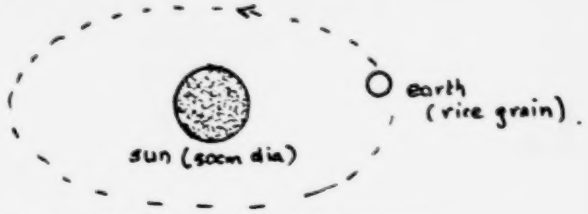
LESSON A : A Core Science Lesson for ALL Pupils

"Sun - Earth - Moon" Teacher notes

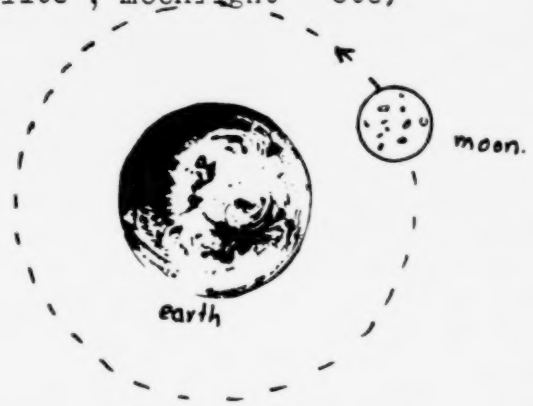
Establish the relative sizes of the earth and sun by referring to a scale model (cf toy car or ship to real sizes).
Use a large beach ball or plastic bin bag filled with paper (diameter about 50 cm) as the sun.
The earth is then about the size of a grain of rice. This is a great surprize to pupils.

Then develop the model to show how the earth moves around the sun in space (introduce the 'year') and how we get day and night.

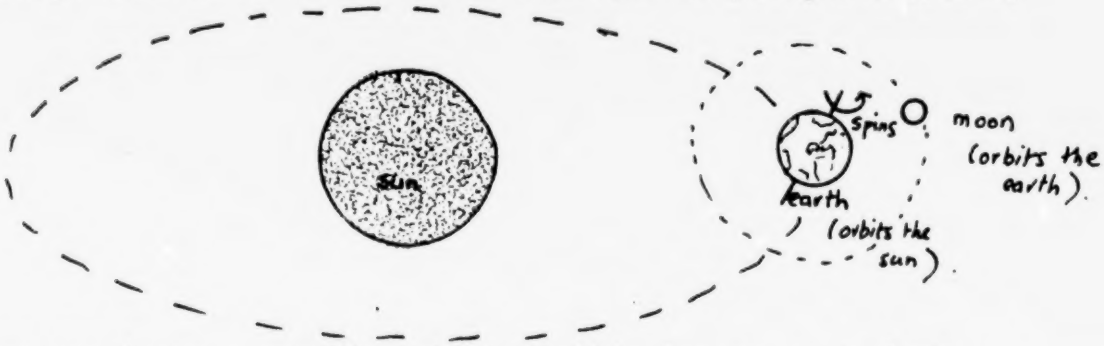


The earth's nearest neighbour can then be considered - the moon. Pupils can be questioned on their knowledge of the moon and some points and words recorded (orbit ; satellite ; moonlight etc)

The movement of the moon aroun the earth can be discussed. Use pupil to hold up the earth while another walks aroun holding a model moon. The moon is smaller than the earth so that a grain of coarse sand is needed to keep the scale correct. For a better understanding the pupils should then use the classroom globe for the earth and a tennis ball for the moon.



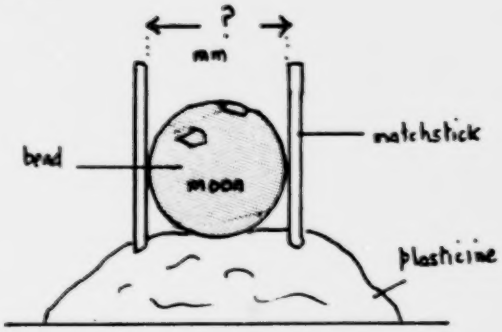
Now consider the " sun - earth - moon" move ments in space using pupils holding the models. Outside or in the gym hall is best to show how the earth orbits the sun in a year (while spinning 365 times or so on its axis) and while at the same time the moon orbits the earth (about 12 times - introduce idea of 'months' but perhaps omit lunar months as it can confuse younger children)



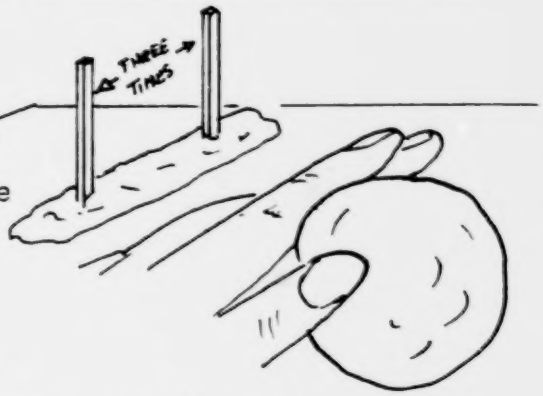
Teachers can issue a question sheet on this lesson or a sheet with statements and blanks for pupils to complete.

LESSON A Individual pupil practical

MAKE A SCALE MODEL OF THE EARTH AND MOON



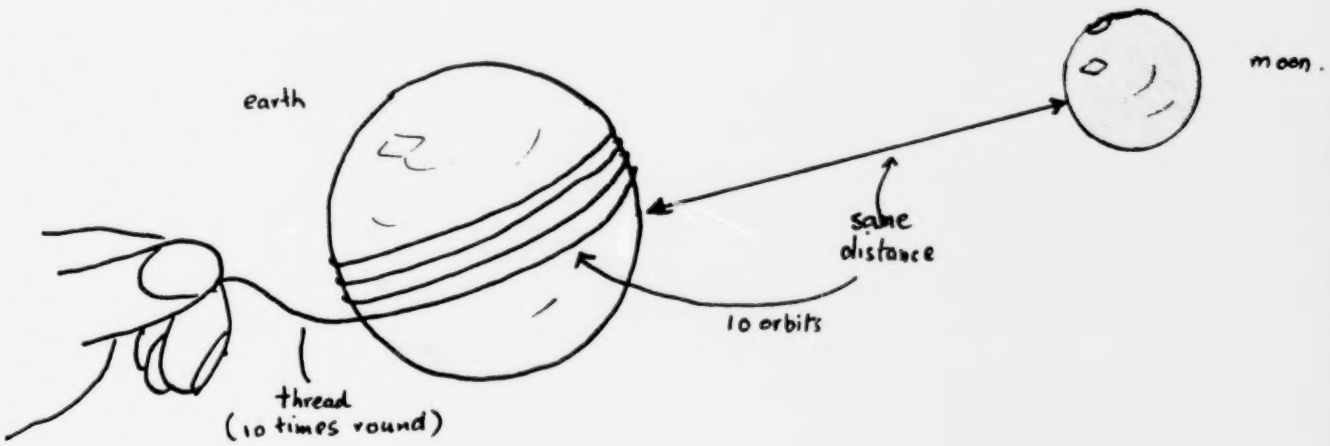
1. Pretend that a small round bead or pea is the moon.
   Now measure in mm the diameter of the moon. The drawing will help you to do this.
   Note your answer carefully.



2. The diameter of the earth is three times bigger than that of the moon.
   Put two match sticks at this distance apart.
   Now make a model earth from plasticine or clay. Do this by rolling a ball which will JUST fit the gap.

   This is the scale size of the earth.

3. Travelling to the moon is about as far as travelling TEN times round the earth.



   Use a piece of thread to measure the scale distance apart of the earth and moon for the model you have made.

   Measure this distance. Note this carefully.
   How does it compare with others in the class ?

4. Label your model and display it in the class (perhaps along a wall).

LESSON B : Science lesson for Group Work

"Phases of the moon"

On a fine night you may be able to see the moon in the sky.

Sometimes you can also see the moon during the daytime.

Remember to go outside and look all over the sky.

If you have binoculars or a telescope you can see the moon much better and make out some details on its surface.

Remember NEVER NEVER look at the sun directly or with a telescope.

Read the books the teacher has left out about the moon and write a short account of something that interests you about the moon.

Keep this sheet carefully in a folder.
Make drawings in the boxes below of the shape of the moon over a period of a month or more. About one drawing every three days will do.

MOON RECORD : drawings of the shape of the moon.

1. Date	2.Date	3.Date	4.Date	5.Date
6.Date	7.Date	8.Date	9.Date	10.Date

"Parachutes"

Parachutes are often used in space work.

Returning space modules or shuttle spacecraft are frequently fitted with a number of parachutes.

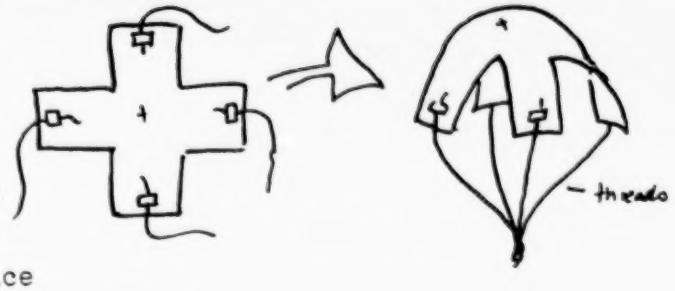
The drawing shows three parachutes attached to a command module at splashdown.

To find out how a parachute works you are going to make one and try an experiment.

Look carefully at the sheet headed "Parachute Testing". Do the following :

1. Cut out the parachute outline.

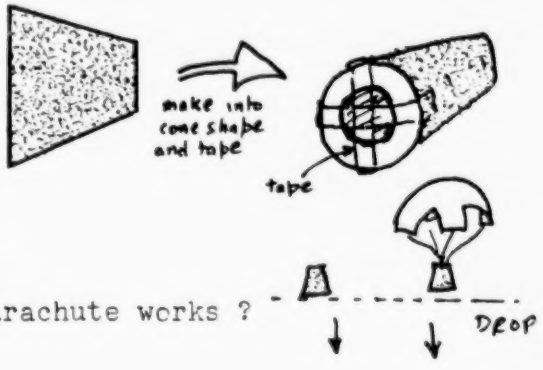
2. Fix threads to the positions marked and gather the free ends together.



3. Cut out and make up the two space modules. Fit a similar size marble inside each (the pretending astronaut).

4. Fix one module to the parachute.

5. Drop BOTH modules from the SAME height at the SAME time. Observe which reaches the floor first. Repeat several times to make sure.



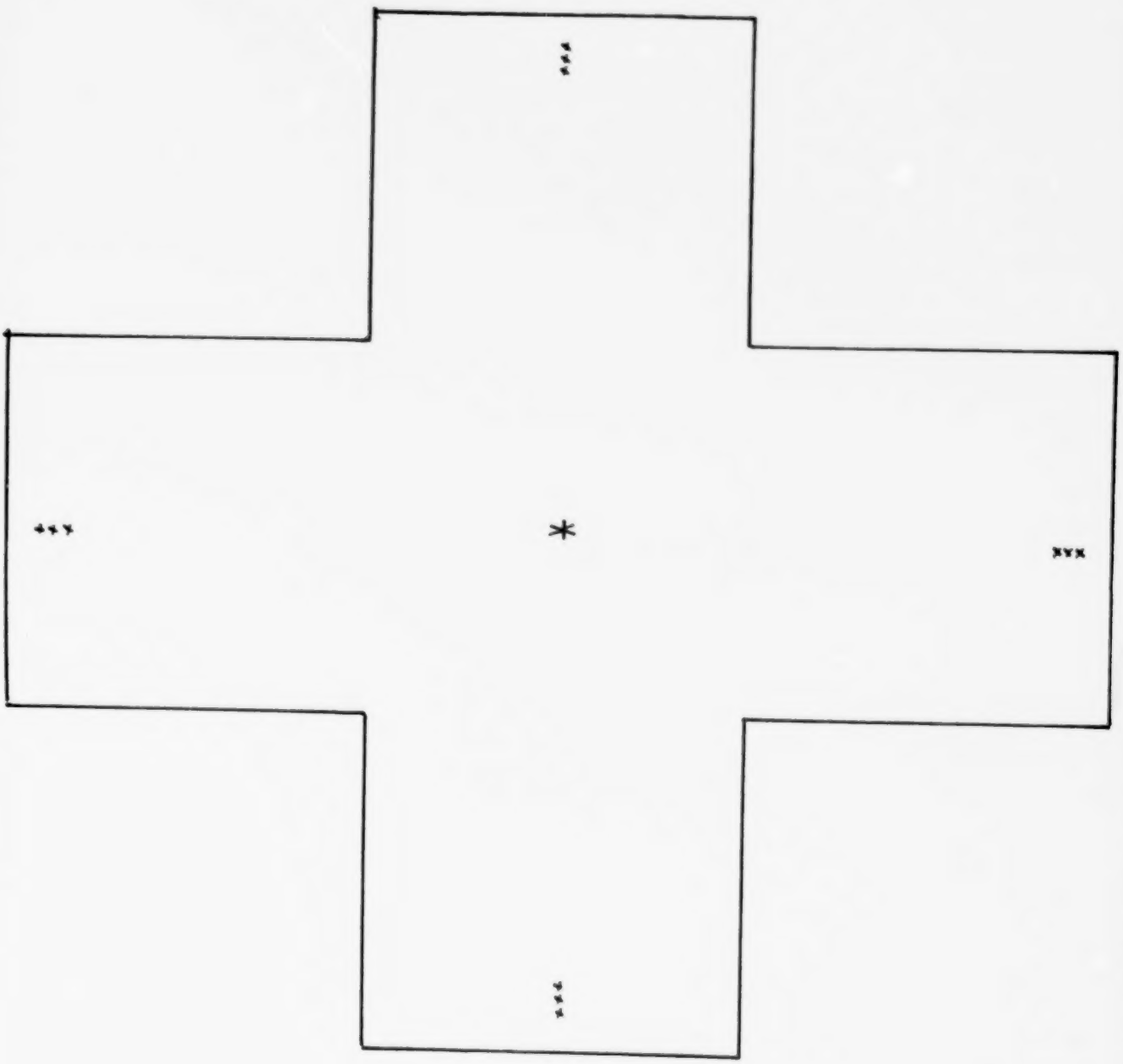
Does this help you to explain how a parachute works ? Write a simple explanation.

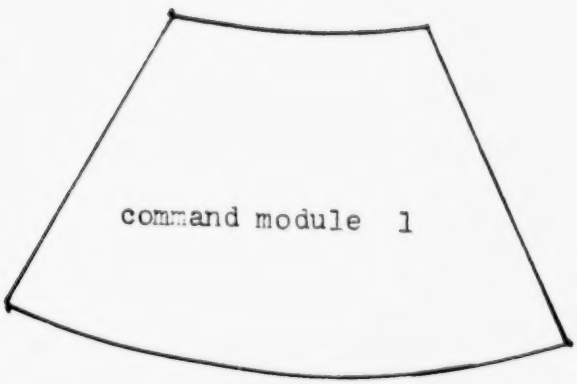
Extension

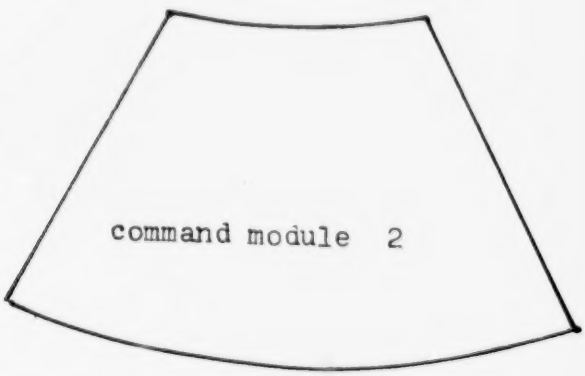
Use polythene or cloth and make a larger parachute. Test this parachute with increasing weights attached to it.

LESSON C : Pupil cut out sheet

"Parachute Testing"

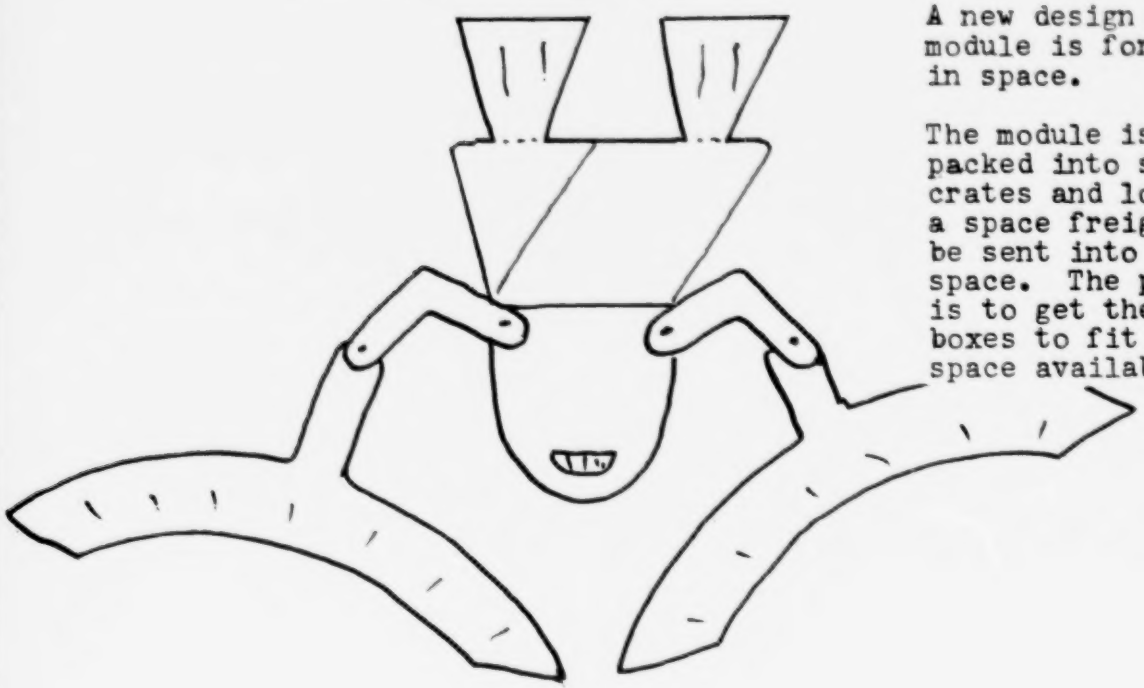






LESSON D : Technology lesson for Group Work

"Space Packing Problem"

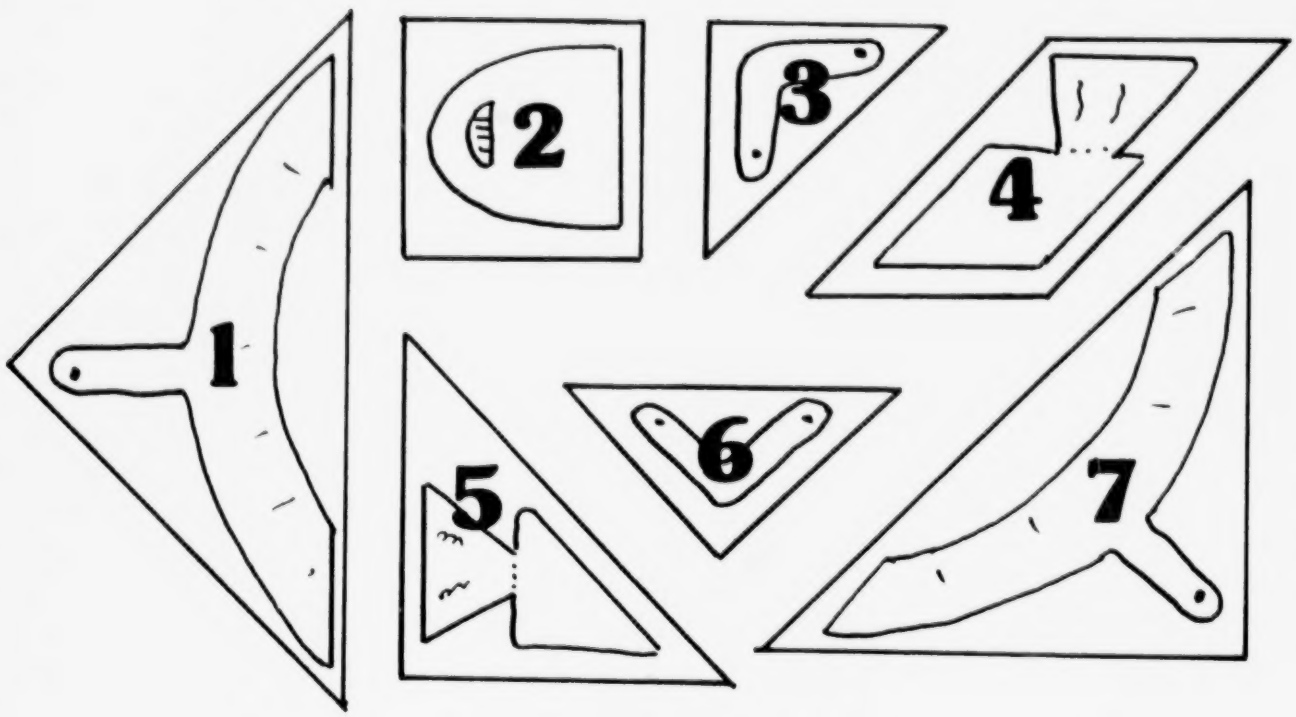


A new design of space module is for assembly in space.

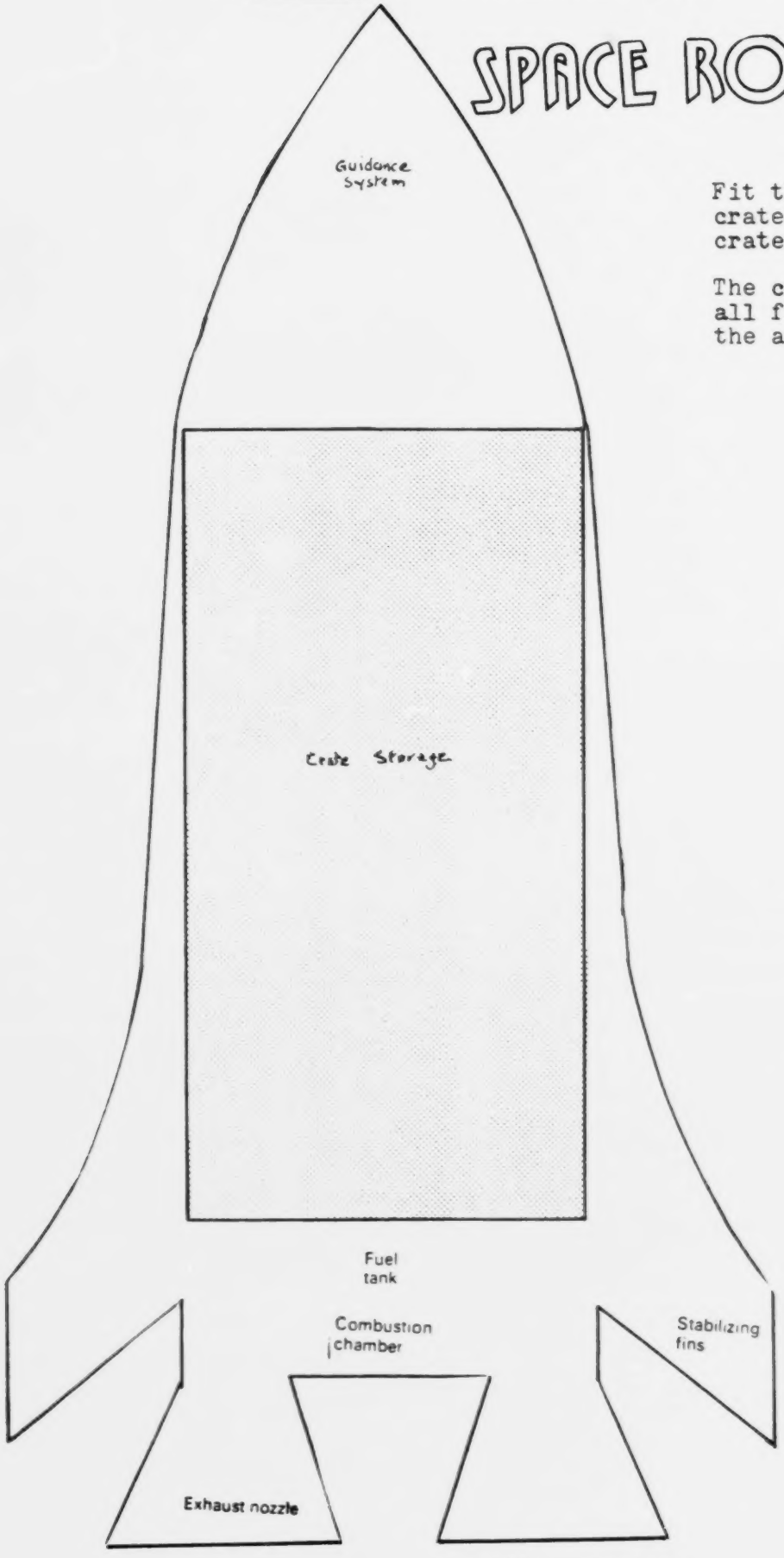
The module is to be packed into seven crates and loaded on a space freighter to be sent into deep space. The problem is to get the seven boxes to fit into the space available.

CRATE SIZES (scale drawings)

Cut out the seven crate shapes given below and fit them into the cargo space. See "Space Rocket "



SPACE ROCKET



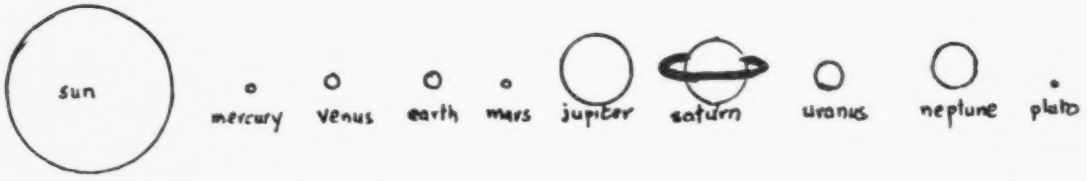
Fit the seven crates inside the crate storage area.

The crates must all fit INSIDE the area.

"Make a Scale Model of the Solar System" Teacher & Pupil notes

The drawing below shows the sun and its nine main planets.
This is called the .....

The drawing is not to the correct scale . It does not show the distances apart nor the relative sizes but only the correct order of planets from the sun.



However, a scale model showing the relative sizes can be made and displayed in the classroom.

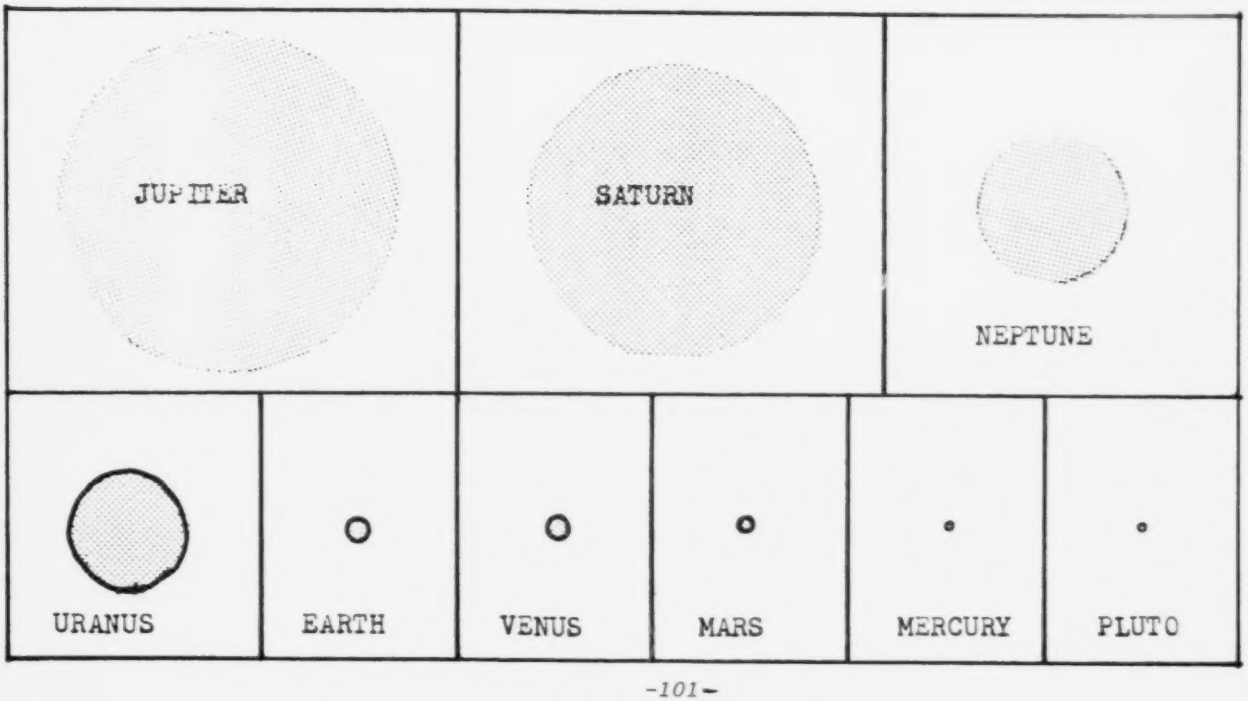
Begin by making a model of the sun. Use a large bin bag filled with crushed newspapers and made into a ball shape. The bag must be about 50cm in diameter.

Your teacher will now put you in groups and give you one of the planets to make up from plasticine.

Tie a thread to your model planet and fix a label to indicate its name.

Make a class model from a selection of the models to show a complete solar system to relative size in the correct order.

....
Cut out the scale outlines below and issue them to class groups.



LESSON F : Technology lesson for Group work.

"Warning Indicator"

Materials : you are supplied with a wide range of materials like :

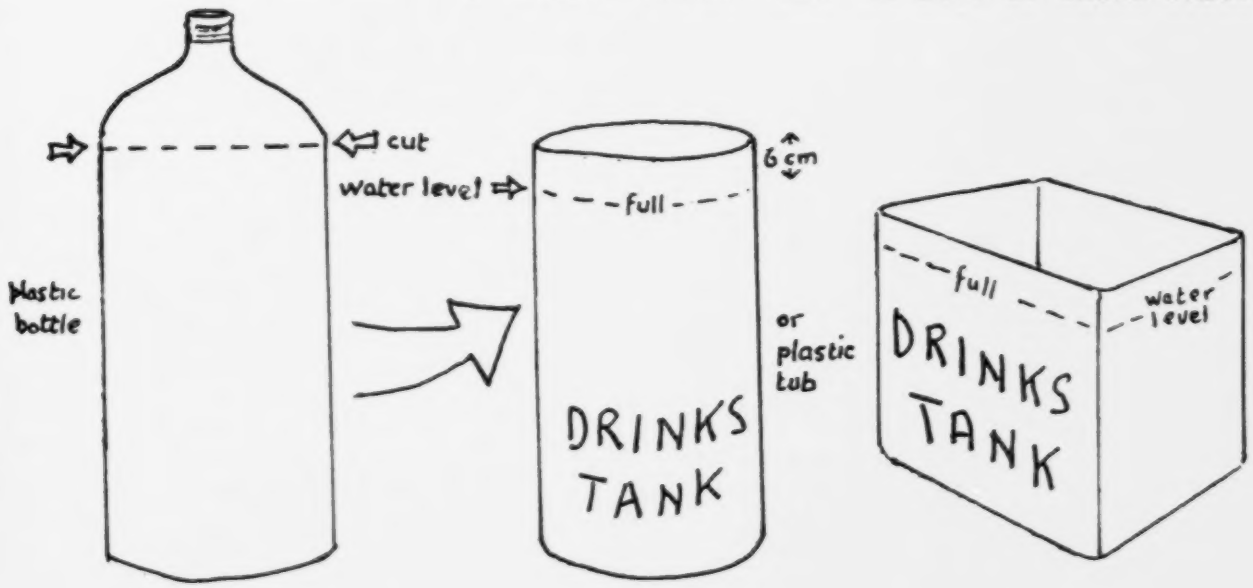
scissors	thin plastic covered copper wire
3v torch bulb and holder	glue and gum
baking foil	polystyrene pieces
big and small corks	hacksaw blade
wood blocks	wood spills
hammer and nails	plain pins and drawing pins
sticky tape	thread
thick and thin card	paper clips

Other simple items if available from your teacher.

Problem

The space ship must keep a very careful check on its drinking water supply. It would be very serious if the 'drinks tank' were to overflow and precious water was lost.

A model 'drinks tank' is made as shown below.



Now you are to make a device which will light up a "WARNING BULB" when the level of water in the drinks tank gets near the top (say 5 or 6 cm from the top).

Begin by talking and thinking of how you might do this.
Write down your ideas. Make a list of the items you think you will need to build your gadget.
Discuss your plans and ideas with your teacher before you start to build.

If you are having difficulties then speak to your teacher.

LESSON G : Technology lesson for Group Work

"Design and Test a Balloon Rocket Message Carrier"

Materials : the following materials are available

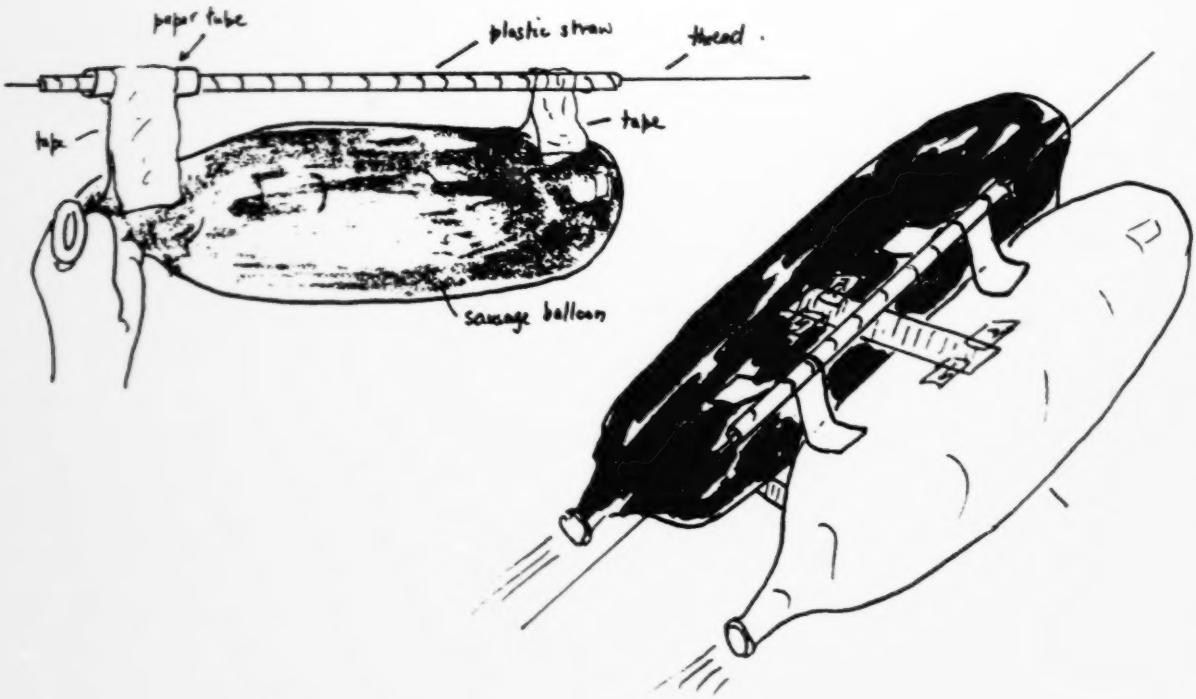
a packet of round and sausage shaped balloons
strong thread
sticky tape
plastic straws and paper straws (or art straws)
paper and thin card
scissors

Problem

You are to design a balloon powered rocket which will enable you to send a message on a standard postcard from one end of the classroom to the other.

Design and test your own rockets to do the job.
Try sausage shaped balloons and round balloons. Compare big balloons to small balloons for performance.

Some ideas are shown in the drawings.



Draw a plan of your most successful design.

Play a friend in the class (or your teacher may arrange a class competition). The fastest rocket to cover the distance wins.

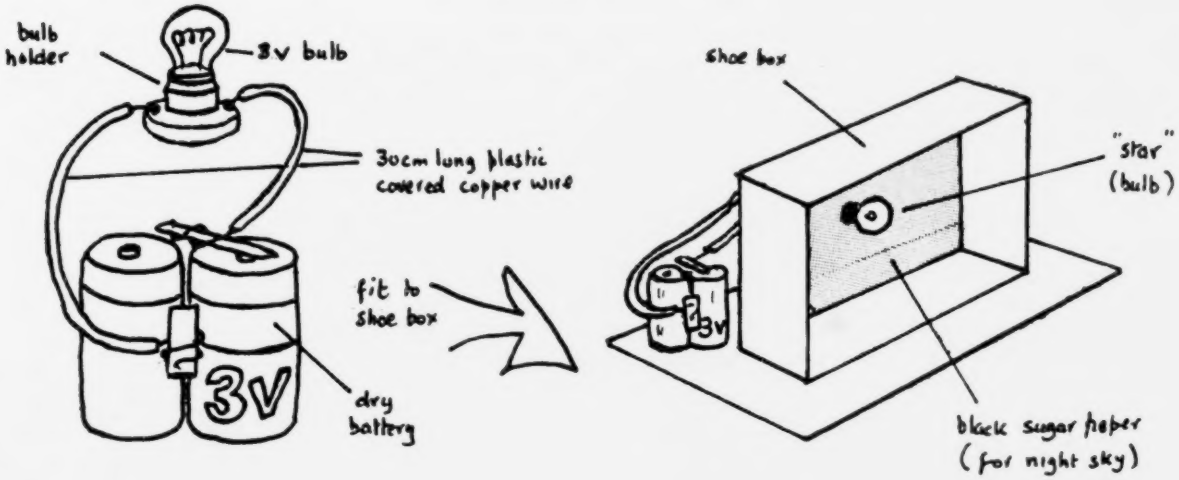
"Stars and Constellations" Teacher notes

Develop the topic by questioning pupils on planets and then stars. Name some planets ? Name a star ? What are the differences ?

Important points to establish are :

Our sun is a star.
Stars give out light and heat from within themselves (cf moonlight)
The night sky seems to be filled with stars. There must be a very large number of stars.

A simple demonstration using a 'model star' can be given to help establish some key points.



Use the model outside over large distances (100m say) - on a dull day preferably. The following can be established in a simple way.

1. When the 'star' is far away, it appears to "twinkle". Clearly, the bulb gives out steady light. Our eye or the air between the bulb and our eye must be giving the twinkle effect.

2. When the star is far away (100m say) it appears small and dim. Close up (10m say) it appears much larger and brighter. Draw from the class that this means we cannot really compare the sizes of two different stars seen in the night sky because they are most certainly at different distances from us. A faint star may in fact be far larger than our sun.

Pupils should be given some important facts about stars , groups of stars and galaxies. This should include :

(a) Our galaxy - the Milky Way.

(b) Constellations - the Plough (or Great Bear or Big Dipper) and Polaris (the Pole-star). Fact that the Pole-star is always due north and how all the stars seem to revolve around it.

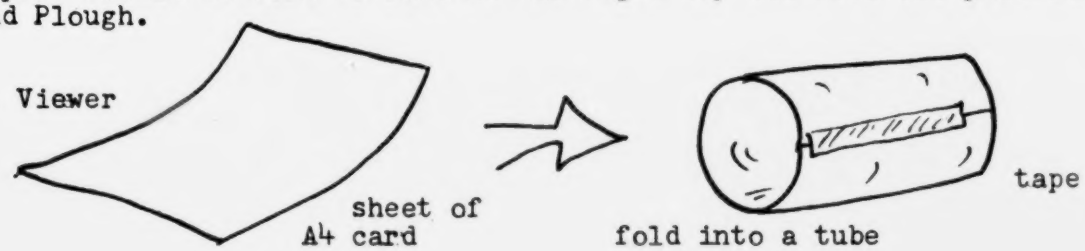
Care should be taken NOT to make this exciting work too heavy. Pupils should move quickly to the practical work.

LESSON H : Individual pupil practical

LOOKING AT STAR PATTERNS : The Plough (or Big Dipper)

Pupils should be told to look at the night sky and seek the pole-star and Plough.

1. Viewer

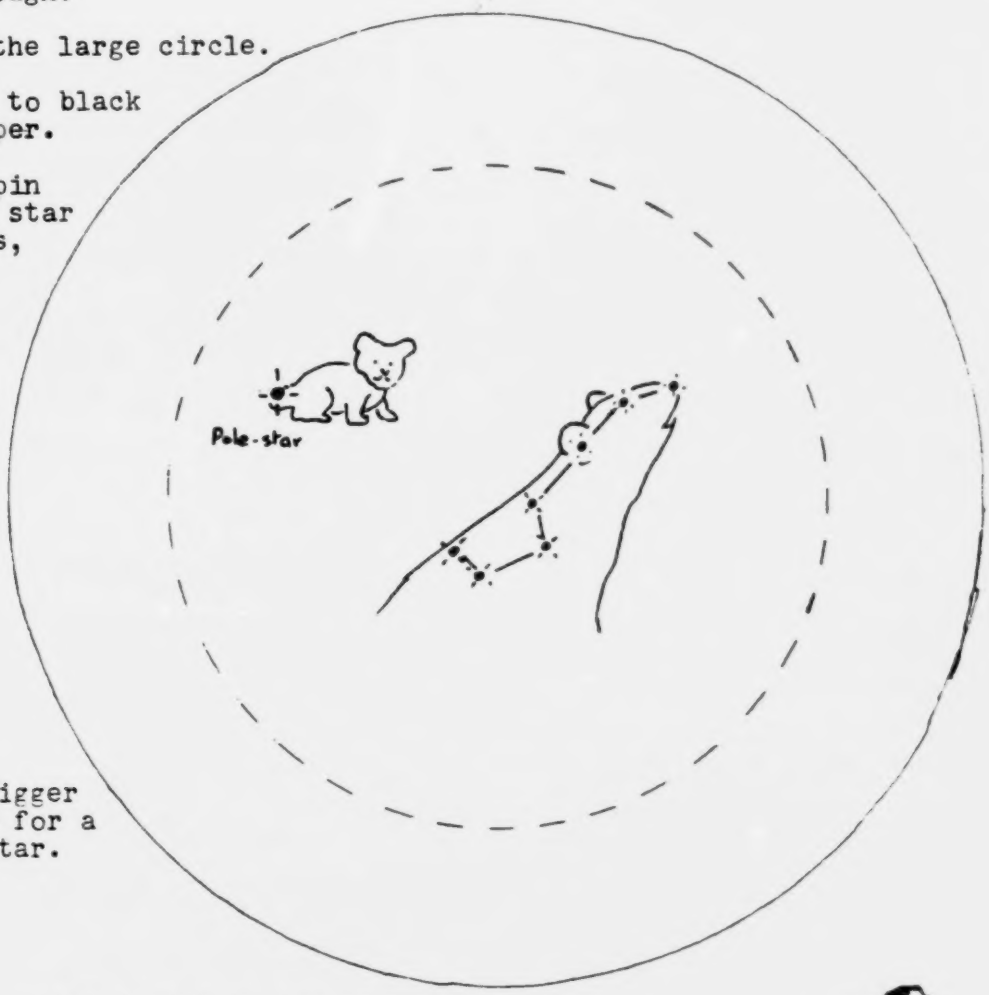


2. Model Plough.

Cut out the large circle.

Paste on to black sugar paper.

Prick a pin into the star positions,

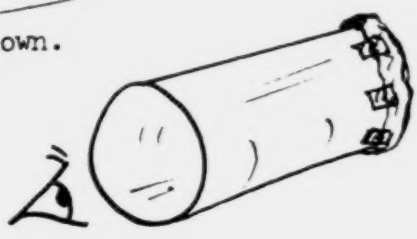


Make a bigger pin hole for a larger star.

3. Tape the model Plough to the viewer as shown.

View the star pattern by holding the viewer up to the light.

Pick out the pole star.



4. Look again at the night sky for this pattern.

Locate other star patterns. Try to make viewer models of these.

Storyline | Teaching Notes

8. Lift-off

8.1 Rockets and Gravity

A simple class lesson is given on "How rockets work" (see 8.1 Science Core lesson). The teacher-pupil interaction enables the theme word bank to be further developed. Pupils can then be issued with a simple cut-out and paste jig-saw of a rocket (see 8.1 Jig-saw) This reinforces the key words developed and the features of a rocket.

Class display - photographs and drawings of real rockets are collected and displayed. This task could be allocated to groups or individuals while others are given other tasks.

8.2 Model rocket - class competition

Pupils are involved in a simple craft-design-technology exercise on making and testing a cardboard rocket (see 8.2 Model Rocket). The model is made from an A4 sheet of thick paper or thin card (by tracing the sheet 8.2 on to a spirit duplicator sheet). The construction is moderately difficult for a 10 year old pupil. Help, guidance and prior card work is necessary. In trials all pupils were highly motivated and wished to make the model.
A good model requires that there are no air leaks. Sticky tape helps to seal gaps. The model should be coloured and tested. A height of 6m is possible although pupils need practice to achieve this.

Design changes should be encouraged (even allow and foster "for the competition design your own rocket from a sheet I will give you")

Each pupil in turn is allowed to test fire their rocket (two tries only) and the greatest height recorded.

Greatest height wins and the pupil can, if you wish, be awarded a "Chief Rocket Technologist" award.

8.3 Sense poem

A language lesson when pupils use their rocket words to express feelings of what it is like at "lift-off".

Video or photographs with readings or sound tapes are very useful for this lesson.

8.4 Play - "Lift off to outer space"

A simple drama lesson can be developed along with some simple art props (costume and stage). Example :

Two astronauts walk on to the stage (front of class even) with space suits on (made from baking foil and cardboard).

Astronauts sit inside a pretend space capsule (two chairs lying side by side on the floor with backs resting on floor)

The class play the role of rocket engines (make roar) when given the cue.
One pupil acts as a TV comentator describing the events (a script is needed). Other pupils are seated at desks and play the role of scientists at 'mission control' (scripts are vital as follows.....

countdown continues 10...9...8...7..

ignite main engines (all class roar)

6. ...5....4..

three seconds to lift-off (voice from mission control)

3...2..1 zero

we have lift-off .....)

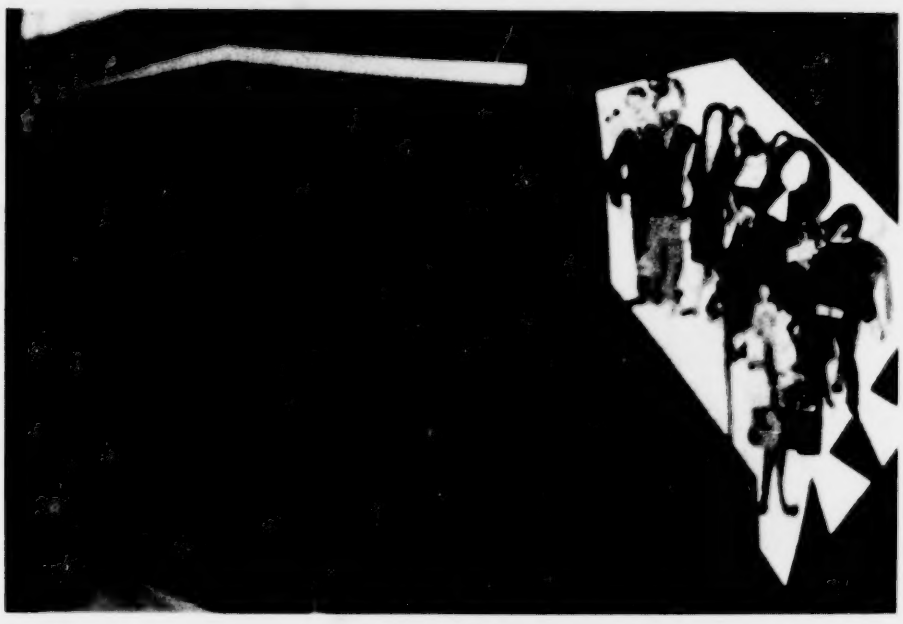
Other possibilities can be introduced and may be suggested by the pupils (accident ... 'abort'.. .)

8.5 Wall display - starships and crew

A large outline of the mission starship can be drawn on thin card and mounted on a wall frieze (long sheet of millskin or plain wallpaper).

The crew figures are pinned bythe pupils in place on the starship for lift-off.
As the mission continues , the rocket outline is moved nearer and nearer the unknown planet (this is a round disc at the far end of the frieze.

See the photograph showing "mission wall display" or the page opposite.



"Mission wall display"

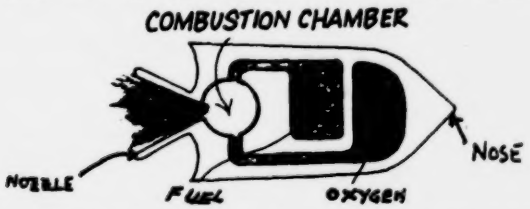
Collage characters are placed on- board the starship for lift off to the unknown planet.

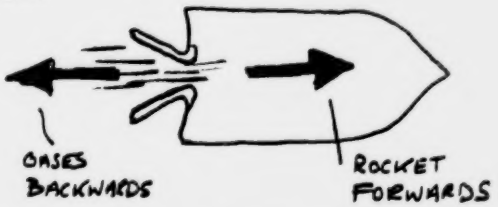
LESSON : Core science lesson for ALL

"Rockets" Teacher notes.

The lesson involves a simple description and history of rockets along with a few qustions and demonstrations of how model rockets perform. Finish outside with the firing of a water rocket (very impressive with young children and rich in follow-up). A brief outline of the sequence might be :

Description of the rocket engine.
Nobody is exactly sure who it was invented the first rocket.
How a rocket works is well understood.





When the fuel and oxygen are mixed and ignited, powerful exhaust gases are produced. These are sent backwards through the rear nozzle. As a result, the rocket is pushed in the opposite direction. The rocket then moves forwards.

Some of these points may be had by accurate questioning using balloon rockets for demonstration.

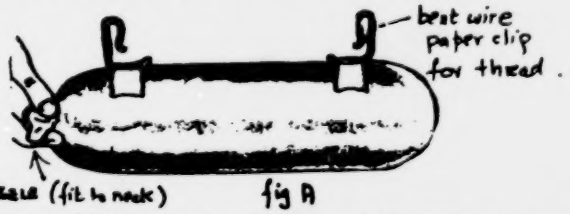


fig A

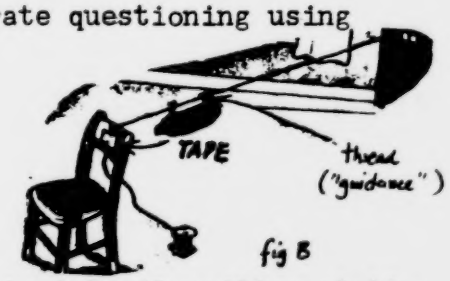
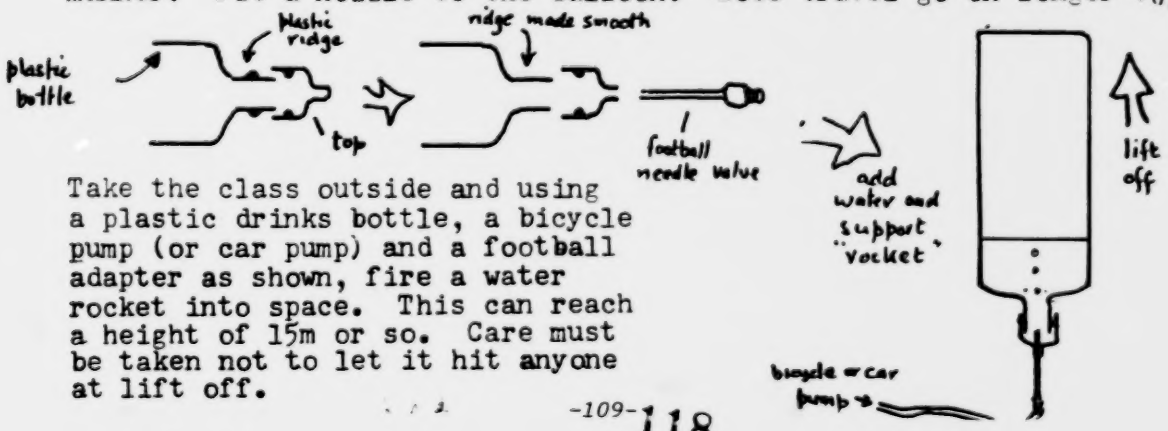


fig B

What problems are there with these rockets ? Pupils will probably suggest all sorts of problems (can't carry people ... who will blow them up if they are to be very big.... etc). Aim to get the important features of
(a) travel at random (direction faults)
(b) soon stop (all gas has exhaused or escaped)

These lead to rockets having 'guidance systems' - vital as the engine. Use a thread guidance on the balloon. (fig B)

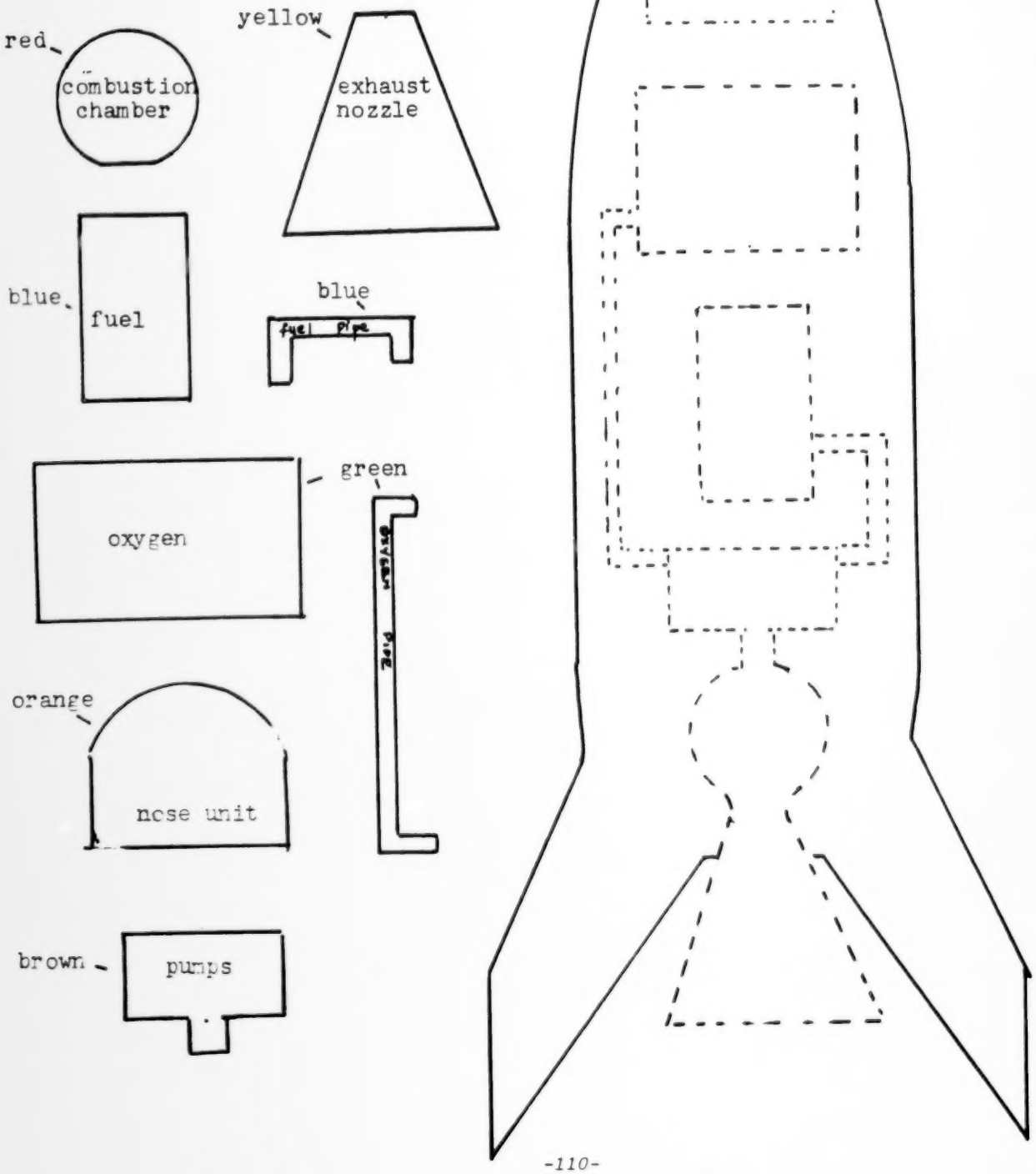
The gases are made to escape in a more controlled and steady manner. Fit a nozzle to the balloon. Does travel go on longer ? (fig A)



Take the class outside and using a plastic drinks bottle, a bicycle pump (or car pump) and a football adapter as shown, fire a water rocket into space. This can reach a height of 15m or so. Care must be taken not to let it hit anyone at lift off.

"Jig-saw cut out of Rocket Engine"

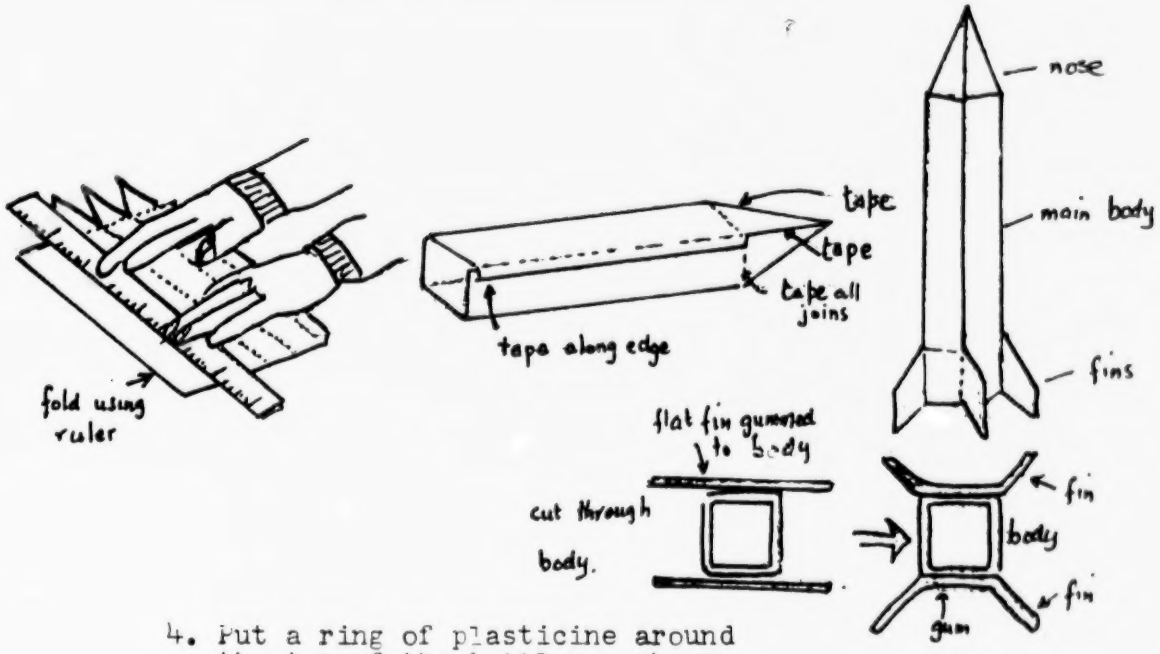
1. Cut out the rocket shape (full lines).
2. Colour the cut outs as indicated.
3. Cut out and gum the cut outs to the rocket.



8.2 a LESSON Class competition instructions for making the first design.

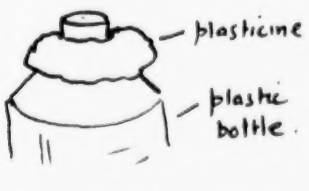
"Model cardboard rocket" Pupil notes

1. Read and do sheet 8.1b.
2. Carefully fold the pieces along the dotted lines as shown in the drawing below.
3. Gum the rocket together.
   Use sticky tape to prevent air leaks.

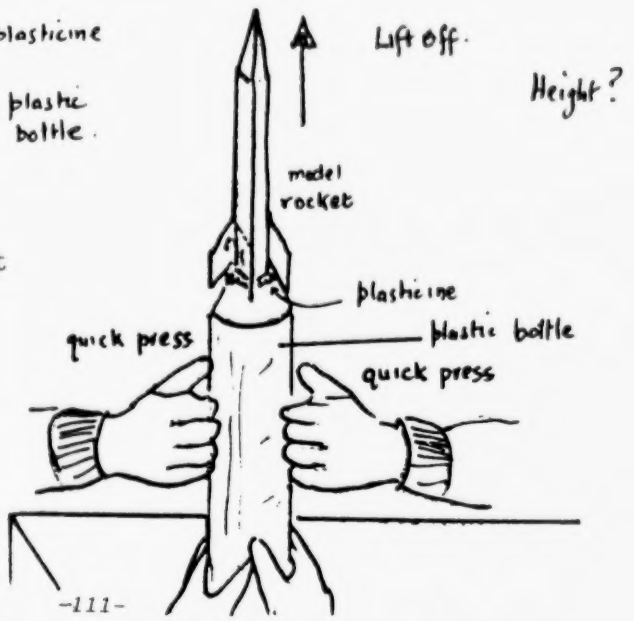


4. Put a ring of plasticine around the top of the bottle as shown.

   Then fit the exhaust nozzle into the plasticine.



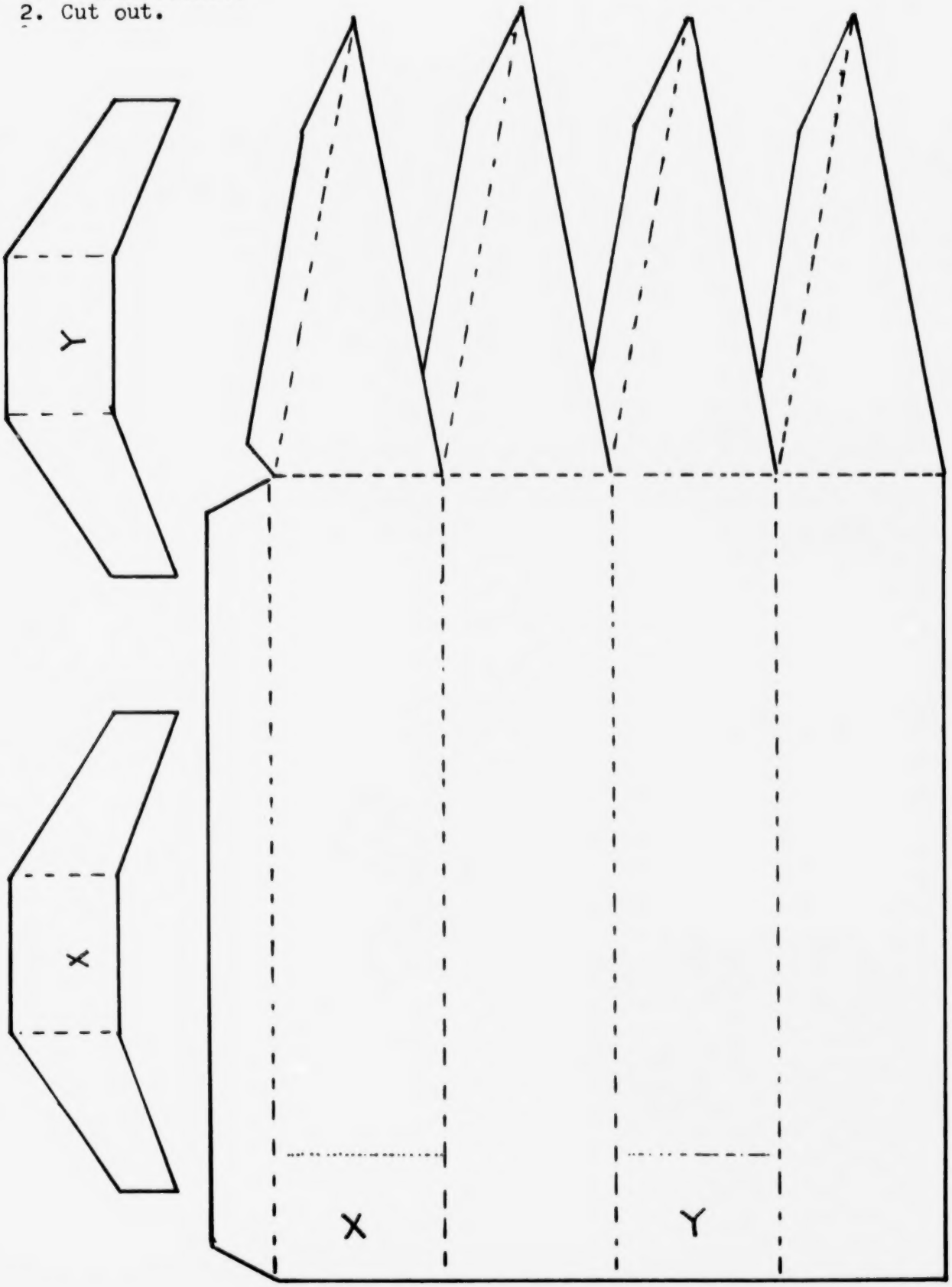
5. Test fire.
6. Measure the greatest height reached.



"Model Rocket Outline"

Trace and print on thin card or thick paper.

1. Colour rocket.
2. Cut out.



Storyline | Teaching notes

9. Travel to the unknown planet

9.1 Space Odyssey Music

Essentially a music lesson making use of well known music on space "Planets" theme and "Space Odysseyr" theme. A variety of modern pieces is available from the many film epics on space .

Pupils should more readily appreciate the change of tempo and feelings expressed in the music since they have at this stage all undertaken a basic core programme covering sun-earth-moon-solar system-stars-rockets...

9.2 Educational games - Interplanetary travel game

To maintain interest and momentum in the theme and to allow pupils to use their space words and ideas a simple game of chance is introduced (note that you may wish to bring this in earlier or later as you see fit).

The game uses a dice and is essentially a variation of snakes and ladders. Pupils, however, are required to EACH make their own game and to complete the set of "Incident Cards" to go with the game. This requires a language lesson involving discussion on possible incidents that could occur on a journey into deep space.
Possibilities.. mechanical failure
illness
disagreement - mutiny.
attack from aliens
dust cloud impact- meteorites
gravity pull
loss of pressure

These and other incidents could be fitted into the game via the set of cards.
First to reach the unknown planet wins the game.

Pupils can make up their own rules eg.

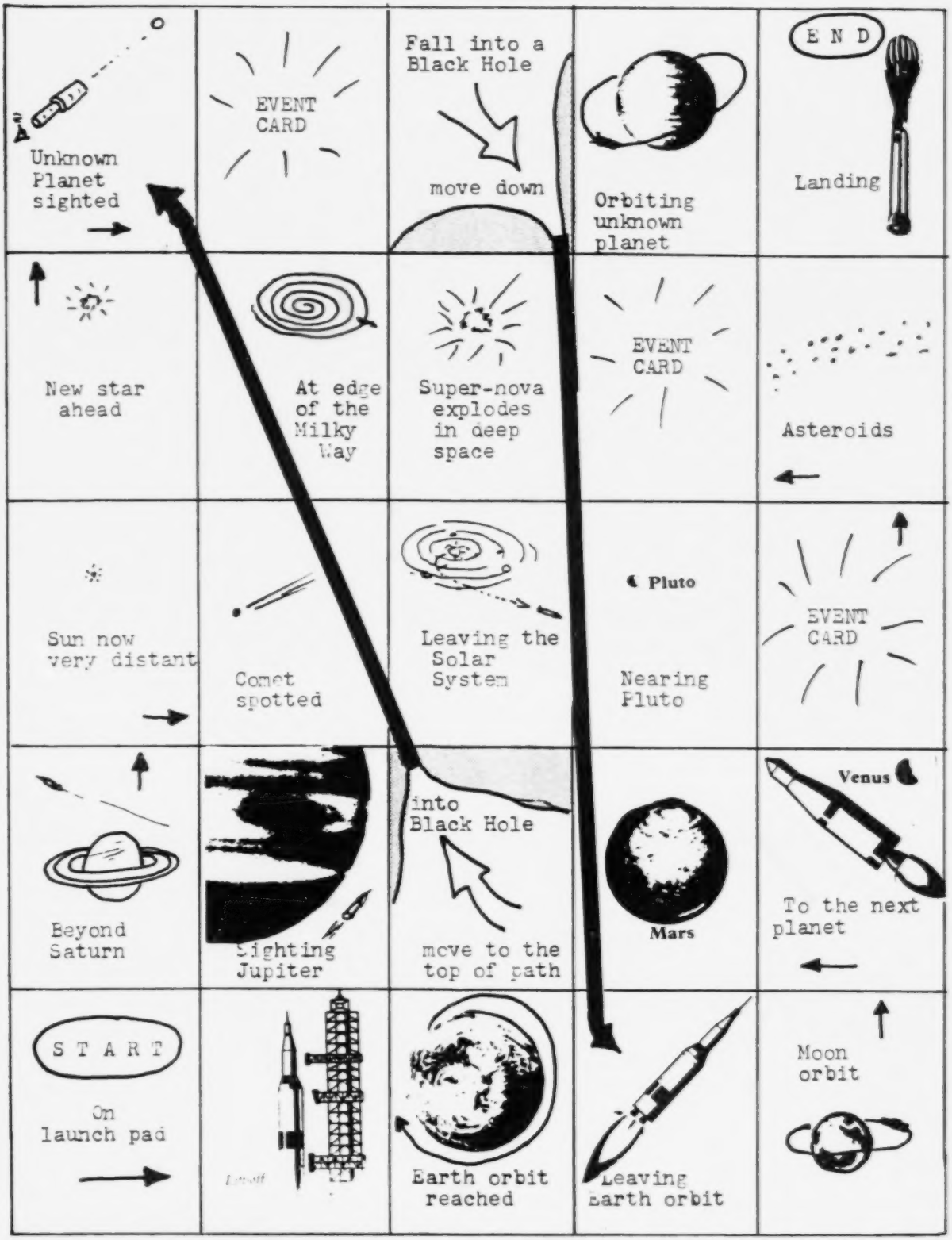
1. Throw a six to start.
2. Then throw again for your first move.

See photograph opposite.

"Unknown Planet Game"

Pupils playing one another with a completed game.

Unknown Planet Game



Game requires a small dice and set of 'Space Event' cards.
Use a rocket shape counter to mark your position.
Throw a six to start and then make your first throw.
First to reach END by an <u>exact</u> throw wins.

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LESSON

Pupil sheet B

"Unknown Planet Game"

INCIDENT or EVENT CARDS

Cut out when complete.

1. Complete the set of cards.
2. You are NOT allowed to go forwards more than 2 places or backwards more than 9 places.

EVENT . Fire main engines. . Move FORWARDS 2 PLACES	EVENT . Air pressure failure - repairs. . Move BACKWARDS 4 PLACES
EVENT . Mutiny amongst crew. . Move BACKWARDS ... PLACES	EVENT . .. . Move BACKWARDS 2 PLACES
EVENT . ... Move FORWARDS 1 PLACE	EVENT ....
EVENT	EVENT . ...

Storyline | Teaching notes

10. Sighting the Unknown Planet

10.1 Sighting the planet- telescopes and binoculars

A short core science lesson on "how a lens gives an image" with pupils looking for features like size, colour, inverted .... What we see when looking at an object through binoculars and telescopes is then introduced to establish the idea of the enlarged image. See standard textbooks of Light for details.

The new words introduced are added to the word bank.

A further experiment for group work on "Making a Simple Telescope" can be added to the science and technology monitoring sheet at this stage. If pupil groups are making swift progress through the scheduled activities then this should be done.

10.2 What the planet looks like

Language lesson in which the pupils "imagine the view through the telescope of the mysterious planet".

Oral descriptions should be made.

Pupils should be asked to further imagine what they see as they get ever nearer and nearer to the planet.... vegetation?....signs of buildings?... rivers?.. creatures?.....

The class after the discussion now writes a description of the planet as an exercise in imaginative storytelling.

10.3 Art form of what the planet looks like.

An art lesson in which pupils paint, draw or make a collage of what they imagine the planet to look like.

Some pupils can be told to depict a close up scene while others can show the planet at a distance.

A wall display in the corridor makes an interesting effect.

Storyline | Teaching notes

11. Landing and Exploration

11.1 Landing on the planet

A language lesson which links closely with the science and technology lessons already undertaken is given. Careful questioning will lead to pupil response. All new words should be noted and discussed. Most questions will have answers which are already contained in the space word banks.

Who will go down to explore the planet ? All of us ?
Will it be dangerous ?
What should the people landing take ?
How are they to get down ? (parachutes ?)
Can people breathe on the planet ?
How can the explorers move about on the planet ?
How will they get back if the planet proves hostile ?

Following the discussion the class are given a narrative to write.. .

"What then happened to me and the other explorers."

11.2 Make and test a planet rover

A history lesson on epic landings on planets by moving machines is given (Apollo moon buggy ; Russian lunahod..)

This is a good lead in to a class group competition of the type

"Make a machine powered by elastic bands which can travel under its own power and carry ten marbles (pretending astronauts)"

See the activity sheet 11.2 Planet rover.

Points will be awarded for

(i) design and finish
(ii) speed over the first 5m
(iii) distance travelled in one winding

This activity is difficult. It requires pupils in groups working together and co-operating with one another. Adequate time must be allocated to the task. It is recommended that the design and making be done in group organisation (see PSDP ideas pages 6 & 7).A special sheet can be issued to pupils in difficulty giving ideas on making an elastic band 'engine' to work their machine.

The finished machines should be kept aside for a coming together in the gym hall (or outside) in the last week of term or of the theme. The competition between groups requires the completion of the speed and distance races. Other classes should be allowed to watch.

The winning groups can be awarded 1st or 2nd or 3rd places according to your wishes.

11.2 LESSON Main class "groups" competition in Technology.

"Planet rover"

Materials : you are supplied with a wide range of materials like

scissors
pliers
hacksaw blade
glue or gum
thick and thin card
wood pieces
plastic straws
small office items (pins..)
plastic bottles
iron wire
selection of elastic bands
small wood beads
cotton reels
thin dowelling or round pencils
marbles

Problem

You have to design and make a machine powered by elastics which can travel under its own power on the floor and carry 10 marbles (the pretending astronauts).

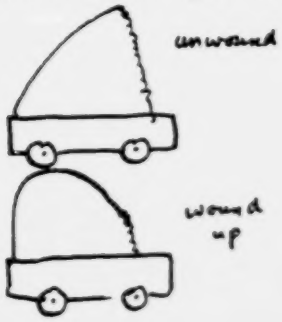
The fastest and longest running machine will win the competition but the design and finish of the model will be taken into account.

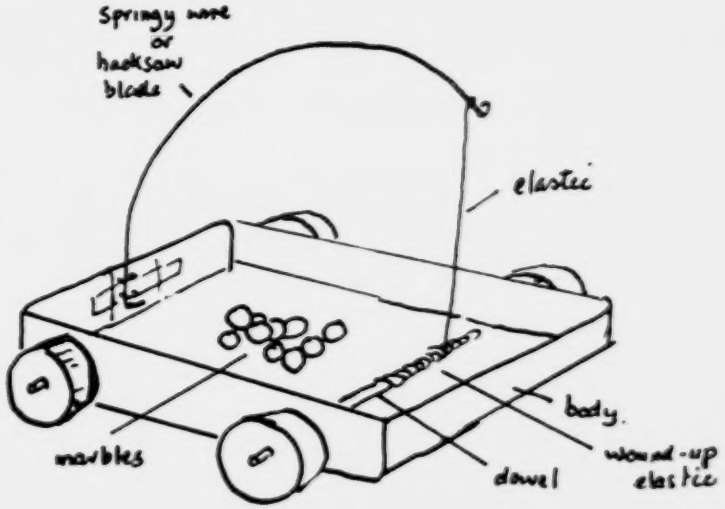
Think about a model design.

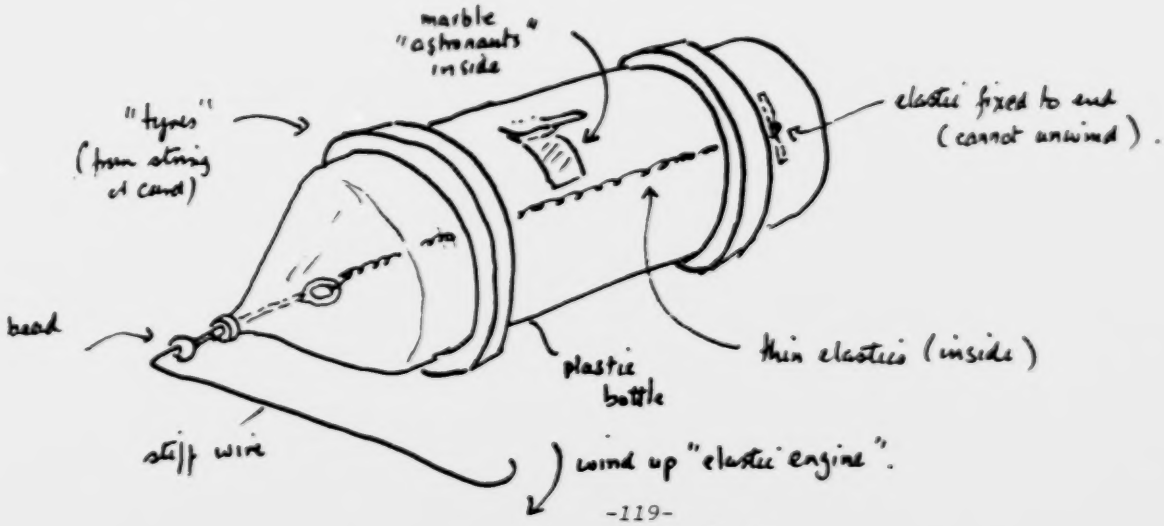
Some ideas are shown.

Write down your plans.

Show the teacher your plans before you start.







Storyline | Teaching notes

12. End Scenario

12.1 Further Exploration (or Return to Earth or ?)

A variety of factors like time availability, resources and so on must be considered at this stage before a decision is taken on the next part of the storyline. School policy for thematic work is of key importance. For a school with a policy of one theme per session then 'Exploration of the Planet' could be developed to cover the next term's thematic work (food needs ? water ? links with the mother starship ? mission control ? houses.. bridges.. monsters.. strange life forms.. and other possibilities which will allow for the use of traditional material in the storyline context)

For a school policy involving three or so themes per session then this theme should now be quickly concluded with the experts and crew gathering samples and returning to earth (or seeking yet another new planet) or settling 'happily ever after' to be joined later by other earthlings.

Rarely does the mission end with disaster - all feared killed on a hostile planet. This could be a conclusion, however, with pupils asked to
"Describe the final outcome of the mission"
in written or oral work. This could be in the form of a report for a newspaper.

12.2 Class Competition - planet rover machines

The technology competition makes a fitting end of theme (or term) climax to the work. The competition requires considerable space. The gym or assembly hall or outside on a fine day are ideal. Other lower classes (and parents) will learn from and enjoy the spectacle. Special 'scorers and judges' should be appointed along with time keepers. Points are awarded according to a set plan (see "Score Sheet" 12.2) and an adult (head teacher or visitor or parent not personally involved) acts as final judge.

Pupils should be allowed to take home the items made (rockets ; rovers ; characters ; ID cards etc...)

This concludes the theme for the term (save for the post test should this be required. This test is best done before the final competition).

13. Post test

See end comment in 12.1

12.2 CLASS COMPETITION

Official Results Name .....

My Group : Number or reference - _____

Names 1. .....
2. .....
3. .....
4. .....

SPEED EVENT

	1st	2nd	3rd	rest
time				
points	10	6	4	2

our score ____

DISTANCE EVENT

	1st	2nd	3rd	rest
distance				
points	10	6	4	2

our score ____

DESIGN and FINISH

Judge will examine the model (maximum points 10) : our score ____

Our total points = [ ]

RESULTS OF COMPETITION

1st : .....
2nd : .....
3rd : .....
Our position : .....

...ooOoo...

APPROACH 2

EXEMPLAR 2

APPROACH 2 SECOND EXEMPLAR

PUPIL ROLE PLAY IN A DEVELOPING STORYLINE

(A) OUTLINE OF METHODOLOGY

The reader should be fully conversant with the previous exemplar describing this method of approach . Ideally the previous theme should have been tested in the classroom situation when the comments to follow will be considered in the light of practical experience of role playing in a developing storyline.

Theme Development "Transport"

This exemplar is NOT detailed (as in the case of "Journey to an Unknown Planet"). It attempts to outline some additional development possibilities in this type of interdisciplinary work involving pupil participation in a developing storyline. The comments should be seen as the natural educational follow-up to the previous exemplar.

The main aim is to allow the reader to take ANY topic or theme suited to the primary school and apply the principles and tactics described so that science and technology is successfully taught in a fully interdisciplinary way.

Key Features of the Approach

Some of the remarks which follow have been stated previously. They are emphasised once more, however, since they must be fully appreciated if successful implementation of the approach is to be realised.

Two aspects requiring careful planning and considerable preparation are of fundamental importance in the approach :

(a) Storyline

Essentially this is the planned sequence of events which will happen in the classroom and around which the role play characters will act.
Usually the storyline begins with the setting of the scene with pupils given a careful and appropriate outline of the physical location (an island : cold lands .. . etc) and the specific point in time. This usually involves some traditional factual lessons in geography and history as pupils rarely have a real awareness of what it was 'like' long ago.

People and their jobs are described (important or otherwise) and this suggests the characters to be introduced and the roles adopted by the children.
Things begin to occur - an event happens which sets a problem - solutions are suggested and decisions made. This leads to certain results and consequences (eg to cross the stream a bridge is built - the builder sets a charge or toll - the bridge puts the ferryman out of work .... and so on with pupils playing the roles). So the storyline progresses and the theme or topic evolves.
Reference back to the first exemplar illustrates this process.

(b) Teacher Lessons and Pupil Activities

This involves careful planning and selection by the class teacher. Where programmes of work exist and are set for the session then these must be examined to ascertain if any of the scheduled lessons readily fit the storyline sequence. If so, then they should be used in the inter-disciplinary work. The lessons chosen should involve the pupils in practising a range of skills and processes in the range of curricular areas. Should one area be particularly weak then additional lessons should be programmed but not as part of the theme. Care must be taken that the inputs to the interdisciplinary theme are not contrived (eg attempting to fit the core programme of science into the theme no matter whether it is relevant or not).

Once decided, the storyline is finalised and planned out with the details of the lessons and pupil activities alongside the sequence of events (refer to page 58 table of development for "Journey to an Unknown Planet")

In carrying out the programme of work pupils will be involved in discussing, reporting, comparing, designing, measuring, testing, designing and so on. It should be planned that they perhaps have to act out incidents in drama and movement , to mime, compose simple tunes or write a simple poem , to interpret a plan or a histogram.. All these activities achieve a smooth integration of the discrete curriculum disciplines. The role play strategy allows for a natural coherence from the menu of lessons from a wide range of subject areas.

A final factor to be considered at the planning stage is that of monitoring pupil performance - especially in the science and technology areas. Clearly all record keeping and performance monitoring must take account of school policy. The simple record sheet used in the detailed exemplar can readily be used to monitor progress in the science and technology areas in any topic or theme.

(B) DETAILED PLANNING STAGES

(1) THEME : "Transport"

Often a theme is very specific and consequently somewhat restricting in terms of planning possibilities. A topic on transport like "The Great Clipper Ships" sets the time and the mode of transport. Historical evidence must weigh heavily in the storyline development. The same is true for many popular primary topics "Vikings", "Hovercraft" ....

When a theme is broad, however, as in the case of "Transport" then a wide variety of possibilities emerge :

Rail transport ; Transport in Ancient Rome ;
Air transport ; The Car Industry ; The Underground
and so on..

Such freedom poses its own particular problems - particularly, selecting and focussing on a rich aspect which will interest and involve pupils while utilising standard proven lessons from the wide curriculum and be sustainable for the duration of the theme. Clearly a variety of factors must be considered at this stage particularly, school policy, previous themes undertaken, teacher confidence in the area and available resources.

(2) MAKING THEME MORE SPECIFIC : "Road and Rail Transport in Britain in (19 "

Once an analysis has been made the theme should be made more specificfor planning purposes. The theme must be set for the pupil in time and physical location.

In the theme specified the time could be now or any previous date since railways appeared. The location could have been a part of Africa or the Wild West of America at the coming of the railways.

Whatever the choice and whatever the theme the strategy employed in the classroom to establish the opening setting should be a wall frieze (or perhaps a 3 D model).

In setting the time and location the characters in the storyline will be to an extent determined. If the 'Vikings' had been the theme, then pupils would make collage figures of Viking invaders along with, say, the Scots or English peoples attacked. The method of making collage characters is identical to that outlined on page 71 . An example appears in the photograph opposite.

Collage figure of Viking made from cloth and felt and gummed to sugar paper or thin card.

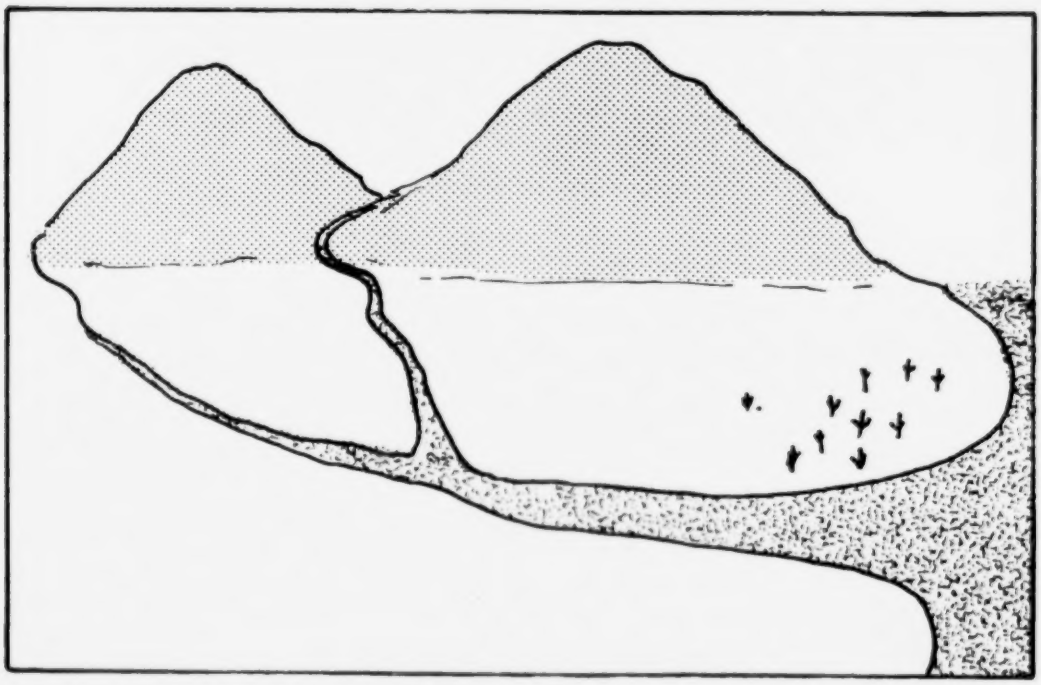
The frieze should be as large as convenient (2m x 1m say). The blank side of a wallpaper roll can be very effective for the base. As pupils require to develop the frieze as the storyline proceeds using card and paper stick-ons a wood surface is not satisfactory.
The physical location is clearly set by the frieze in a way which pupils readily understand. The period at which the events take place must be established by planning a series of set lessons (this may not always be necessary).

Initially the frieze is bare and the details still to be added. The extent of the changes to be made will clearly depend on the period and the country (eg a red indian village starting point can quickly be reached but not the scene for the location of an airport for a large city)

Given the bare frieze a useful technique is to use the pupils to add features until you reach the desired scene for a start to the theme. Pupils by suitable questioning can suggest the vegetation (Trees can't be on marshes or top of mountains etc). They make this from coloured paper and stick it in place on the frieze.....

trees houses water mill
marshes factories farm and so on

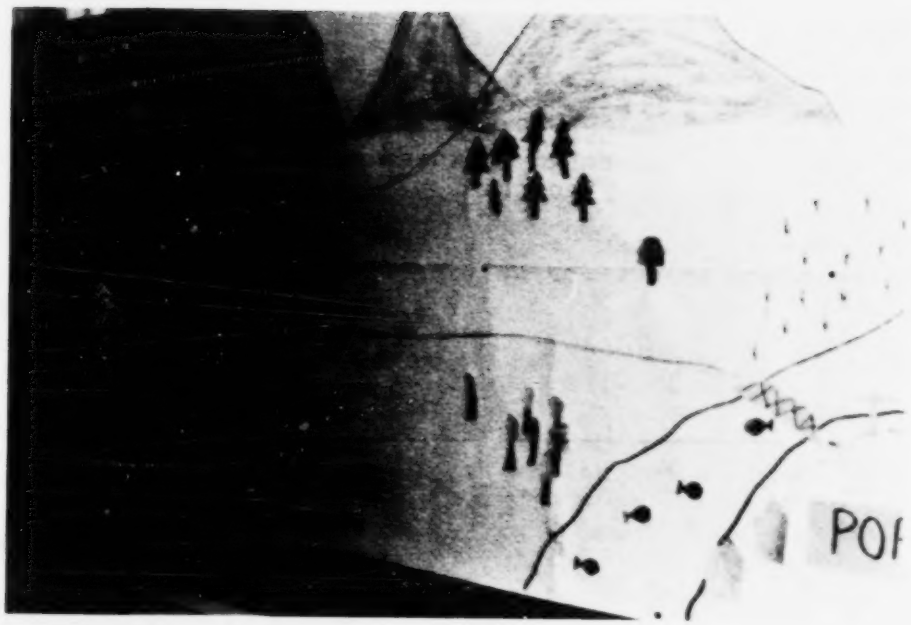
Alternatively, you can prepare the frieze in advance so that the stage is set for setting the time and introducing likely characters.



Frieze - base made from two overlapping strips of wallpaper (plain back side used)

Typical outline - mountains, rivers , sea and plains.

See photograph opposite.



Wall frieze partly developed by pupils

(3) PLAN THE STORYLINE

There is a very close planning link between the storyline production and the activities.

A recommended tactic is to sift through the available print resources and select out suitable lesson possibilities and pupil activities. Set programmes of work in the main curricular areas which are scheduled for the term or session should be scrutinised for material related to the theme. The storyline is then planned in detail and cognisance taken of the bank of items gathered.

The initial planning steps are usually :

Storyline	Lesson
Introduction	Setting the scene - wall frieze Develop the frieze Historical aspects - people, place, environment ....
Characters	Details of people - those that are most likely to become involved in the events. Collage figures Character descriptions
Events sequence.	? ? ?

At this stage a variety of possibilities may be planned.

If the theme "Road and rail transport in Britain in 1860's" is considered then the following possibilities may be decided on.

Roles : pupils take on the role of

road workers and navvies	railway people
bridge builders	farmers
Tavern or Inn workers	robbers
tunnel builders	tinkers
electricity supply people	travellers

or the like

Events : a variety can readily be thought up :

		Curricular area.
(1)	Tom Smith, the local packman, loses his livelyhood with the coming of good roads.	Discussion Language
(2)	Problems of crossing rivers, marshes, hills, gulleys.....	Science Technology (series of practical activities)

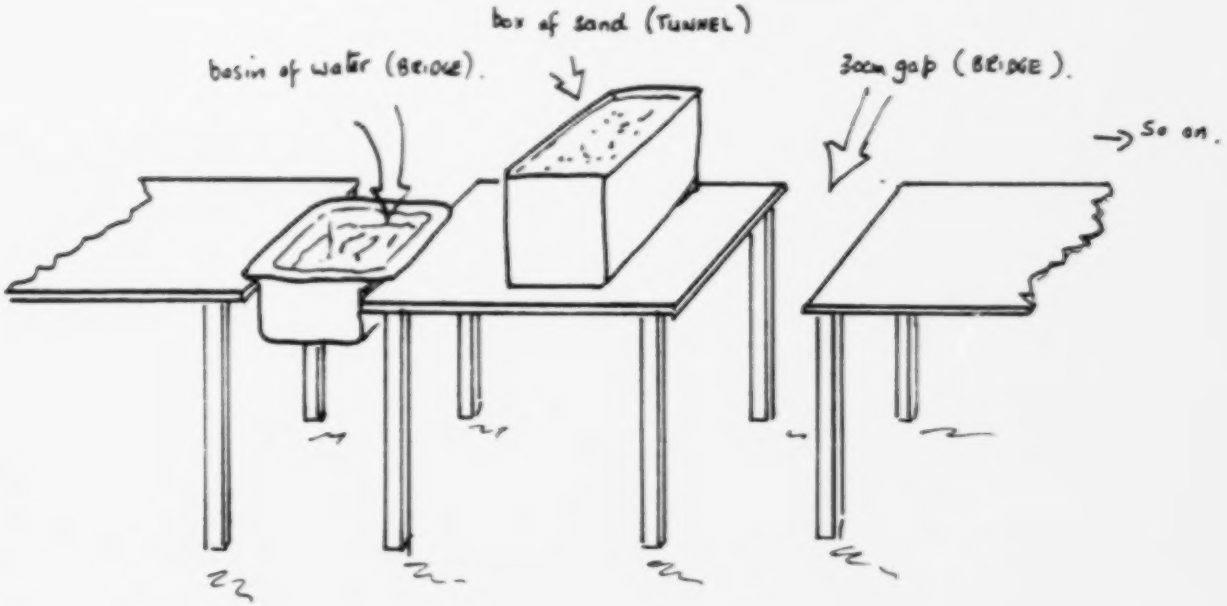
(3)	Tired workers and weary travellers are refreshed at the local Inn or Tavern . Where is it located ? Its name ? Design the building. Who works there ? What do they do ? Tales - robbers ! ghosts ! ...	Art/craft Music Language Poetry Drama
(4)	Who builds the bridges ? Navvies or ? Do you get across free ? Tolls ? Are the road and rail bridges the same design ?	Language History Science Technology

and so on.

One happening can lead to other consequences or, instead, a new event is introduced and the storyline moves on.

The storyline thus develops steadily with the frieze being constantly built up with the events and character involvement. Finally a conclusion stage is reached.
In this theme the most fitting conclusion is for the road and rail links to be completed successfully with the frieze showing this.

An exciting and highly motivating variation is to utilise the planned science and technology work in a much more relevant way. This is done by building a 3-D model along with (or in place of) the frieze. The groups thus build bridges or roads or inns ... as they proceed and these are placed directly on the model. The photographs show the initial and final stages of how this is done.
A toy electric train (00 gauge) can be fitted in a straight track along the rail bridges while a toy car can be driven on the road system. Along with suitable lighting (again using the scheduled science activity)at the tavern , town, railway station etc the effect is very exciting to the pupils, parents and others. See the photographs.



Student teacher groups at work on the different bridges and tunnel problems in a 3 D layout.

Pontoon bridge group at work.

(4) SPECIFY THE ACTIVITIES

As has been stated, these are closely related to the storyline development. The science and technology input, however, is readily programmed from the substantial variety of materials available for pupil work.

For the theme under consideration some of the likely headings are :

Wheels	Speed
Inclines	Tunnels
Steam engine	Materials
Cars	Bridges
Friction and lubrication	Structures
Gears	Frameworks
Viaducts	Electricity

to mention the most obvious.

P S D P Booklet 8 "Resources" gives a list of recent published material from which activities can be drawn.

(5) IMPLEMENT

The theme is now introduced and the events take place as outlined in the storyline. In the reality of the classroom situation some flexibility must be adopted in following the planned sequence of events. Teachers must expect to modify and alter the plan.

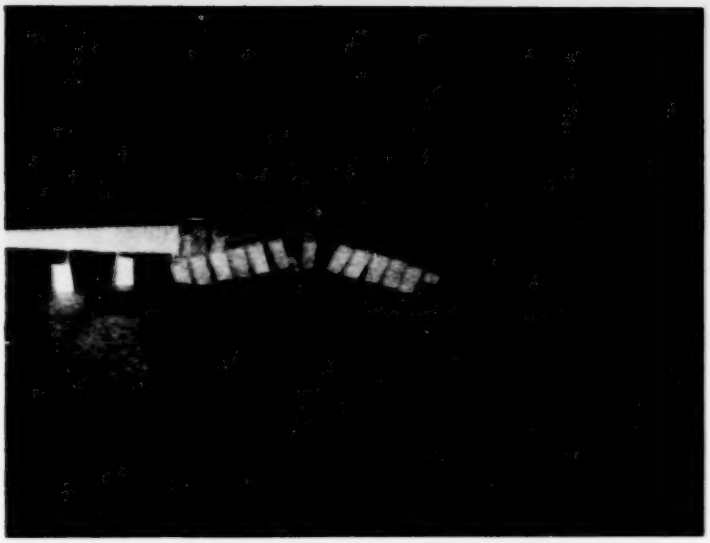
(6) CONCLUSION

The final conclusion stage for any theme requires careful consideration. The danger that the theme simply 'runs out of steam' or 'dies out' is a major problem to be avoided.

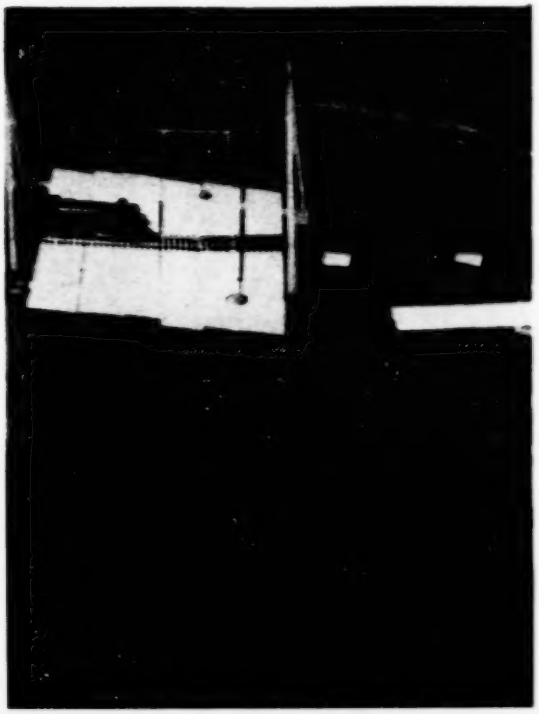
The detailed exemplar used a final class competition to sustain interest and enthousiasm as the theme neared its end. In the exemplar being discussed a working 3-D table model is suggested. Clearly, it is not always possible or feasible or, perhaps, desirable to use these tactics for a conclusion. An attempt, however, to do something different at the final stage of the theme is recommended.

Finally, details of the work undertaken along with any pupil assessment data should be suitably recorded.

....ocoOoco....



Toy electric train moves over the completed 'stone arch' bridge (made from empty match boxes)



Locomotive moves across the completed suspension bridge (made from strips of card, thread and lolly sticks)

Train passing through the tunnel (box of sand used for the mountain)